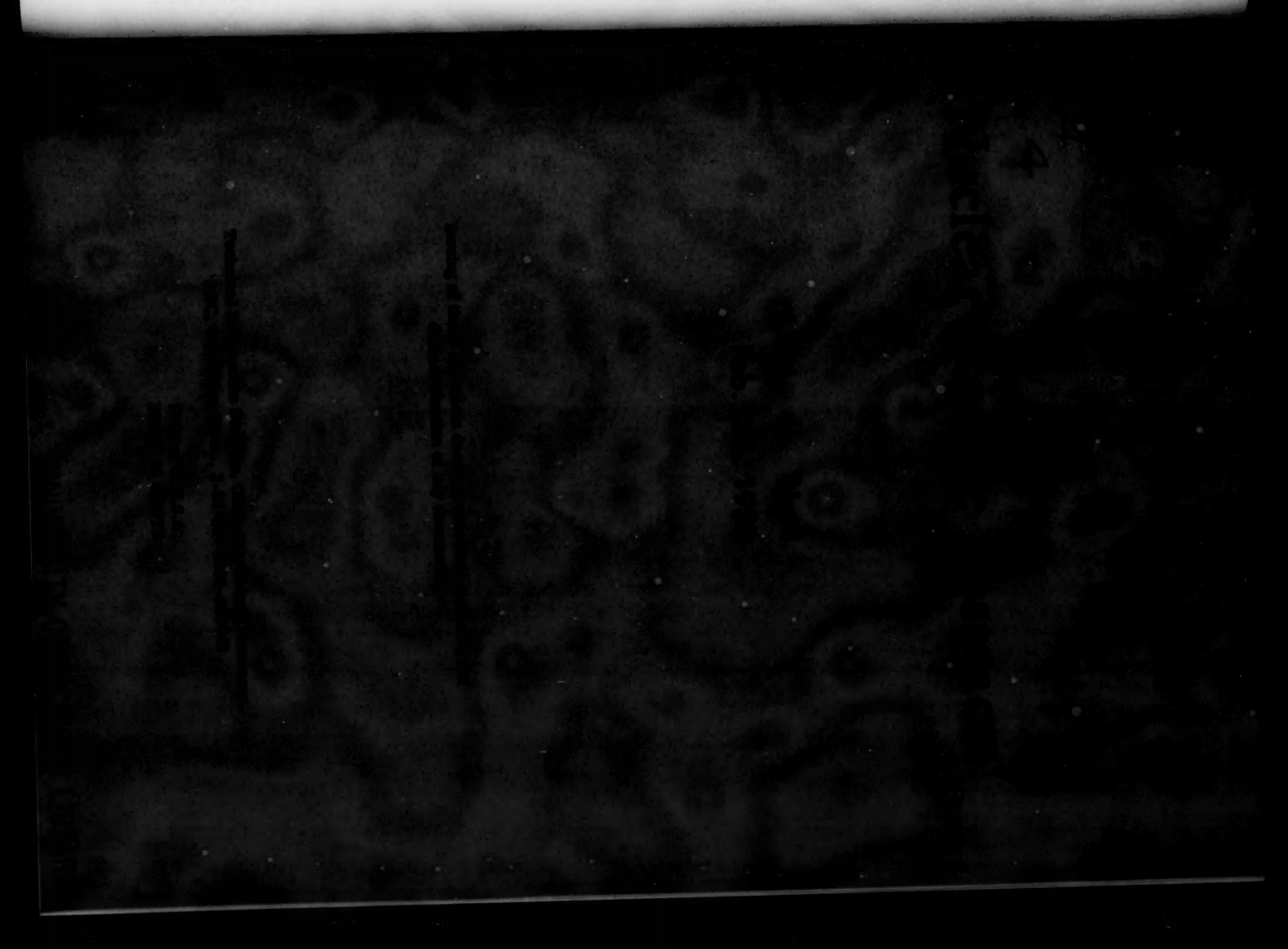

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NUCLEAR SCIENCE ABSTRACTS

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GENERAL

922 The Part Played by Chemistry in the Production of Atomic Energy. Bertrand Goldschmidt. Chimie & industrie 61, 449-56(1949)(in French).

This is a popular account of the sub-atomic and chemical processes that are utilized in the large uranium and plutonium plants in USA, and in the plants near Paris, France, viz., the uranium pile at Châtillon and the uranium-purification plant at Bouchet. The efforts for the production of uranium metal, pure graphite, and beryllium in France are mentioned, as well as the two-year project, now under way, on a new 1,000 kw pile at Saclay.

923 Possible Effects of the Introduction of Atomic Energy on the Chemical Industries in France. Robert S. Aries. Chimie & industrie 62, 497-502(1949)(in French).

On the basis of statistical data, the outlooks for the industrial use of atomic energy are discussed, as well as the changes that its introduction might bring about in the present relationships between various branches of chemical technology in the world, and particularly in France. Since that country is comparatively poor in domestic fuel, the introduction of a new source of energy would, in all probability, give rise to a more intensive exploitation of various mineralogical products of the soil. However, no radical change in the general industrial organization of France is likely to occur.

BIOLOGY AND MEDICINE

924 Haemoglobin Estimation: A Method of Haemoglobin Estimation Using Micro-Glass Cells in Hilger Spekker Photo-Electric Absorptiometer. C. Sanders. Atomic Energy Research Establishment Report No. AERE-H/R-405, Sept. 1949. 14p.

A method of hemoglobin estimation using micro-glass cells in the Hilger Spekker Photoelectric Absorptiometer is described. Red blood cell dilution pipets are used for both the dilution of the blood and as a suitable receptacle for the diluted sample until readings are to be made in the absorptiometer. The method eliminates the personal differences between different workers. The results are read directly from a chart of translated absorptiometer drum readings prepared when the original calibration of the instrument takes place. (auth)

925 A Rapid Colorimetric Method for the Determination of Sodium in Biological Fluids and Particularly in Serum. Gilbert C. H. Stone and Joseph W. Goldzieher. J. Biol. Chem. 181, 511-21(1949) Dec.

A rapid colorimetric method for the determination of sodium in biological fluids (serum sodium) is presented in which the sodium is precipitated as the sodium-uranyl-zinc triple acetate; the stability of the complex and the effect of temperature on it was studied. It was found that the accuracy of the method is within 1% or better of the true reading. 12 references.

926 Beryllium Granulomas of the Skin. Frank R. Dutra. Arch. Dermatol. and Syphilol. 60, 1140-7(1949) Dec.

BIOLOGY AND MEDICINE

Five cases of chronic granulomatous inflammation of the skin and subcutaneous tissues following the introduction of beryllium or beryllium compounds are presented. The histologic relationship of the granulomas of the skin and similar granulomas which occur in the lungs of persons who have inhaled beryllium-containing dusts in industry is described; cure followed excision of the lesions in all cases.

927 Diffuse Pulmonary Granulomatosis in Young Women Following Exposure to Beryllium Compounds in the Manufacture of Radio Tubes. Report of Five Cases. Paul Slavin. Am. Rev. Tuberc. 60, 755-72(1949) Dec.

Five young women developed chronic pulmonary beryllium granulomatosis characterized by shortness of breath, coughing, high pulse rates, and weight losses after exposure to beryllium compounds in radio tube factories; their cases are presented here in detail. It was found that in the first case, added exposure took place during the process of removing the insulation from copper beryllium wires. On analysis of the cases, the author states that the illness appeared to be less severe in those cases in which the nodular dissemination was followed by a marked connective tissue proliferation; calcification of the nodules was noted in the first and second cases discussed.

928 The Metabolism of Sodium Isobutyrate-1-C^{14} and Sodium Isocaproate-1-C^{14} in the Rat. Heinrich Hauptmann and Irving Gray. UCRL-537, Dec. 1, 1949. 11p.

Rats were injected intraperitoneally with sodium isobutyrate-1-C^{14} and sodium isocaproate-1-C^{14}, respectively. The $C^{14}O_2$ expiration rates and the specific activities of the excreta and of the fat, protein, and glycogen isolated from the liver were determined. The results are consistent with the hypothesis that isobutyric acid is decarboxylated while isocaproic acid is degraded by β-oxidation with formation of acetic acid. 11 references.

929 The Absorption and Disposition of Orally Administered I^{131}-Labeled Neutral Fat in Man. Malcolm M. Stanley and Siegfried J. Thannhauser. J. Lab. Clin. Med. 34, 1634-9(1949) Dec.

Tracer experiments on 18 patients, including 10 normal subjects, involving the use of I^{131} for measuring the absorption and utilization of fat, are presented. Commercial olive oil was iodinated with the tracer and fed in 5-ml amounts (containing 100 μc of the I^{131}) to the subjects. The radioactivity of the thyroid gland was determined by serial counting at a distance of 35 cm from the neck with a shielded γ tube; the serum and urine of each patient were also tested for radioactivity. Characteristic curves of absorption and utilization of physiologic amounts of lipid were demonstrated; the proportion of the administered iodine which was collected by the thyroid and excreted in the urine, and was found in the water-soluble portion of the serum indicated the extent of the breakdown of the labeled fat. It was found that in normal subjects, degradation of 50-73% of the orally administered iodinated fat took place within 24 hr; subjects with "idiopathic" hyperlipemia and the nephrotic syndrome utilized the fat much more slowly.

BIOLOGY AND MEDICINE

930 The β-Carboxylases of Plants 1. Some Properties of Oxalacetic Carboxylase and Its Quantitative Assay. Birgit Vennesland, Miriam C. Gollub, and John F. Speck. J. Biol. Chem. 178, 301-14(1949) Mar.

Some properties of oxalacetic carboxylase and its preparation from parsley root are described; the results obtained by fixation of $C^{14}O_2$ in oxalacetic acid during enzyme decarboxylation by parsley root preparation and in organic acids during incubation of the parsley root protein with L-malic and pyruvic acid substrates are included. A method for the quantitative assay of the oxalacetic carboxylase is presented. The enzyme was shown to be associated with a malic dehydrogenase; the reversibility of the enzyme was demonstrated. The properties of the enzyme are compared with those of pigeon liver oxalacetic carboxylase. 20 references.

931 Calcium Ion Exchanges in Some Normal Tissues and in Epidermal Carcinogenesis. A. I. Lansing, T. B. Rosenthal, and M. D. Kamen. Arch. Biochem. 19, 177-83(1948) Nov.

The radiocalcium, Ca^{45}, turnover of normal bone, blood, epidermis, dermis, and liver, as well as that of experimentally induced hyperplasia and squamous cell carcinoma were studied in Swiss mice. The Ca^{45} was injected subcutaneously in the early experiments and intraperitoneally in the majority of experiments; a standard injection solution containing about 2 mg/cc solution (about 60,000 counts/min) was used. The animals were sacrificed at various intervals and the blood, liver, bone (portions of the tibia and the femur), and epidermis were removed for analysis. These experiments indicate that epidermis, unlike other soft tissues, actively exchanges calcium. In early methylcholanthrene-induced hyperplasia there is a loss of storage capacity in epidermis for this calcium. Thirty-day hyperplastic epidermis and a transplantable squamous cell carcinoma are characterized by an inability to exchange calcium ions.

932 Concerning the Preparation and the Metabolism of Radioactive Iodocasein. R. Courier, J. Rouche, G. H. Deltour, M. Marois, R. Michel, and F. Morel. Bull. soc. chim. biol. 31, 1029-34(1949)(in French).

The digestive assimilation and the mammary excretion of iodine in iodocasein in rabbits was studied with the aid of I^{131}. The intraperitoneal injection of labeled iodocasein and labeled KI into lactating rabbits was followed by the mammary excretion of minute quantities of the administered iodine and even more minute quantities of iodoprotein; the thyroid bodies of the nursing offspring absorbing the milk of the treated animals fixed the iodine according to the modality. The irregularity of the gastric resorption explains, it is stated, the differences in biological activity of the iodoprotein prepared by different techniques. It is concluded that the efficacy of an iodoprotein is necessarily the function of both the thyroxin content and the method of use, and that the iodine and iodoprotein are assimilated in variable quantities after the injection of the iodinated protein into the mother.

933 The Conversion of Glycine into Serine in the Intact Rat. Warwick Sakami. J. Biol. Chem. 178, 519-20 (1949) Mar. (Letter to the editor). (See also NSA 4-590 and 4-603.)

A possible pathway for the conversion of glycine into serine was investigated through the use of glycine labeled with C^{14} in the methyl position; the possible pathway consisted of the deamination and subsequent decarboxylation of the glycine, with the formation of a formate. Four fasted rats were given 5 mM by stomach tube per 100 g body weight; after 14 hr the animals were sacrificed and serine was isolated from the livers and degraded as previously described. The serine was found to contain C^{14} in both the α- and β-carbon atoms with almost as much activity in the β as in the α position. The experiment indicated that under certain conditions glycine itself may be a major source of the formate derivative for its conversion to serine.

934 Conversion of Octanoic Acid to Rat Liver Glycogen, Studied with C^{14}, C^{13}-labeled Octanoate. Victor Lorber, Margaret Cook, and Joe Meyer. J. Biol. Chem. 181, 475-9(1949) Dec.

Two types of octanoate (one labeled with C^{13} in the carboxyl carbon and the other with C^{14} in the β carbon atom) were prepared separately and mixed together prior to use; the mixed octanoate was fed to two 24 hr-fasted male albino rats in a dose of 1.1 mM together with 3.38 mM of glucose/100 g of body weight, by stomach tube. Respiratory glycogen was collected throughout the experiment; after 3 hr, liver glycogen was isolated, hydrolyzed to glucose and degraded. It was found that the distribution of the isotopes in the resulting liver glycogen was consistent with octanoate metabolism via 2-carbon fragments arising by β oxidation. The two isotopes entered the respiratory CO_2 at identical rates, but relatively more C^{13} than C^{14} appeared in the liver glycogen. The possible significance of this finding is discussed.

935 The Degradation of L-Lysine in Guinea Pig Liver Homogenate: Formation of α-Aminoadipic Acid. Henry Borsook, Clara L. Deasy, A. J. Haagen-Smit, Geoffrey Keighley, and Peter H. Lowy. J. Biol. Chem. 176, 1383-93(1948) Dec. (See also NSA 4-592.)

The synthesis and resolution of lysine labeled with C^{14} in the ε position and the synthesis and resolution of α-aminoadipic acid are described; it was found that the latter compound is formed from L-lysine in guinea pig liver homogenate, D-lysine being inactive. Over the pH range of 7.5-9.0, the reaction was found to be fastest at pH 7.5; boiling destroyed the catalytic action of the homogenate. The α-aminoadipic acid could be separated from glutamic acid by chromatography on starch. 28 references.

936 Determination of Total Body Sodium in Man with Radiosodium. Gilbert B. Forbes and Anne M. Perley. J. Lab. Clin. Med. 34, 1599-1600(1949) Nov.

A method is presented for the determination of total body sodium with the aid of radioactive sodium, Na^{24}. Thirty determinations were run on 27 healthy men; Na^{24} was administered intravenously and when it was in equilibrium with extravascular sodium (about 18 hr later), it was con-

cluded that the serum specific activity should equal the total body specific activity; by the use of an equation the total body sodium was calculated and found to average 41 meq/kg of body weight. In a series of 17 children the average values were 43 meq/kg for the older children, 49 meq/kg for the younger children and 82 meq/kg for the small infants.

937 The Direct Estimation of the Rate of Thyroid Hormone Formation in Man. The Effect of the Iodide Ion on Thyroid Iodine Utilization. Malcolm M. Stanley. J. Clin. Endocrinol. 9, 941-54(1949) Oct.

A method is described for the direct measurement of the total iodine accumulation by the thyroid gland, using the thyroid I^{131} uptake, the specific activity of the simultaneously excreted urine, and the specific radioactivity in the serum. Thirty-one euthyroid and 13 untreated thyrotoxic subjects were studied by this method; in all instances a tracer dose of 100 mc of I^{131} was administered by mouth. At hourly intervals for 6-12 hr the radioactivity in the thyroid gland was measured with a γ counter, and urine and blood samples were collected. The iodine collection by the thyroids of 14 of the euthyroid individuals who did not receive additional iodide averaged 10 μg/hr; the corresponding average for 13 thyrotoxic patients was 120 μg/hr. When small amounts of added iodide were given, the total iodine uptake was increased; with larger additions of iodide, inhibition of organic binding iodine in the thyroid gland occurred. The degree of inhibition appeared to be determined by the level of iodide in the thyroid cell; the serum iodide level necessary to produce inhibition in the thyrotoxic patients was 5 μg% or less, and was 6-12 μg% in the euthyroid patients. 10 references.

938 Distribution of Gold in the Animal Body in Relation to Arthritis. J. J. Bertrand, H. Waine, and C. A. Tobias. J. Lab. Clin. Med. 33, 1133-8(1948) Sept.

The excretion of radioactive gold, Au^{198}, was studied in white rats, rabbits and humans in an effort to determine its distribution and relation to arthritis. The isotope was synthesized into radioactive gold sodium thiosulfate which was administered intravenously; the tissue samples and excreta were weighed after the injection into the animals and were analyzed for the isotope. A preliminary distribution study was also run on a human arthritic patient. It was found that the results on the distribution of the isotope conform to previous data on stable gold; the synovialis, the tendon, and the articular cortex in chemical arthritis show a greater uptake of gold than similar tissues of normal joints, and this was shown to be nonspecific since the muscle wall of sterile abcesses exhibits the same phenomenon. The passage of the gold from the blood stream into the central nervous system and ocular structures of rabbits was demonstrated. 12 references.

939 Distribution of Zinc in Normal Blood and Organs Studied by Means of Zn^{65}. Bert L. Vallee, Rex G. Fluharty, and John G. Gibson, 2nd. Acta Unio Intern. contra Cancrum 6, 869-73(1949). (See also NSA 2-342.)

Measurements of the zinc content of normal dogs demonstrated that zinc is present in all organs of the body; after the intravenous administration of Zn^{65}, the isotope was also found to be distributed to all the organs, and remained in the body up to six months later. There was no evidence of specific localization of the isotope in any organ studied; doses used resulted in irradiation of 0.001-0.06 r/day. The isotope was transmitted across the placental barrier in a pregnant dog and was found in each of its nine pups on parturition. The zinc content of erythrocytes and leucocytes was very low, with the leucocytes in dogs containing 100 times the concentration of the erythrocytes; human leucocyte concentrations of zinc were 25 times that of erythrocytes. The results of studies on zinc metabolism by the white and red blood cells suggest to the authors that zinc plays an important part in the metabolism of tissue and blood cells, and that the body has a mechanism for its conservation and reutilization.

940 The Effect of Age on Calcium Binding in Mouse Liver. A. I. Lansing, T. B. Rosenthal, and M. D. Kamen. Arch. Biochem. 20, 125-30(1949) Jan.

The present study on the changes of calcium binding with age employed a method essentially based on the quantitative tracing of the distribution of radiocalcium, Ca^{45}, in the livers of yound and old mice, using ultrafiltration to separate the free and the bound calcium. A total of 1 cc of $CaCl_2$ solution (containing 1 mg/cc as Ca and about 50,000 counts/min as Ca^{45}) was injected into Swiss mice of both age groups. The animals were sacrificed at 6, 12, 18, 24, 30, 36, 48, and 72 hr after injection and bled; the livers were collected and ultracentrifuged and aliquots of the ultrafilterable and the nonfilterable portions were removed for calcium analysis. The data indicate that in young tissue, the calcium uptake is low and turnover is rapid, while in old tissue the calcium uptake is high and the turnover is low. The suggestion is made that intracellular calcium may be largely associated with a lipid and a ribonucleoprotein complex.

941 The Effect of Carbohydrate on the Oxidation of Fatty Acids by Liver Slices. Sidney Weinhouse, Ruth H. Millington, and Bernice Friedman. J. Biol. Chem. 181, 489-98(1949) Dec.

The theory that carbohydrate inhibits ketogenesis by competitively inhibiting fatty acid oxidation was tested by measuring the effect of endogenous glycogen and added pyruvate on the rate of oxidation of a series of short chain fatty acids isotopically labeled, the extent of oxidation being determined by the amount and isotopic content of the respiratory CO_2. Such fatty acids as octanoic, hexanoic, butyric, and acetic acid, were labeled with C^{13} in the carboxyl carbon and were incubated in Warburg flasks with liver slices from stock colony male rats (some of which were fasted for 24 hr prior to the experiment and had lowered glycogen contents). It was found that ketogenesis was inhibited in the liver slices from animals which had been fed prior to the experiment; it was also inhibited by the addition of pyruvate when acetate and butyrate were used as substrates, but was essentially unchanged when hexanoate and octanoate were used. 26 references.

BIOLOGY AND MEDICINE

942 The Effect of Thyroid Secretary Activity on the Distribution of Radioiodine in Plasma. Albert M. Potts, Reginald A. Shipley, John P. Storaasli, and Hymer L. Friedell. J. Lab. Clin. Med. 34, 1520-5 (1949) Nov.

Patients with hyperthyroidism or myxedema and euthyroid subjects were studied with I^{131} in order to determine the actual rate of hormone excretion by the thyroid under various conditions. The tracer dose of 0.1-0.2 mc (occasionally 0.4 mc) of I^{131} was given orally; no normal subjects received more than 0.1 mc of the isotope. Blood samples were drawn at intervals of 2, 8, and 24 hr after ingestion of the tracer dose; the method of isolation and estimation of the activity in the organic and inorganic fractions is described. It was found that in hyperthyroidism the activity of the inorganic fraction of the blood declined more rapidly than normal after the iodine administration, while in myxedema the decline tended to be somewhat slower than normal. The activity of the organic fraction was distinctly elevated in all types of cases at the end of 2 hr, and then tended to decline between the 2d and 8th hr; this decline was progressive in normal and myxedematous patients during the ensuing 16 hr, but in hyperthyroid patients there was a progressive rise.

943 Effect of Thyroxine and Thiouracil on the Rate of Phospholipid Turnover in the Liver of the Rat. Eunice V. Flock, Jesse L. Bollman, and Joseph Berkson. Am. J. Physiol. 155, 402-8(1948) Dec. 1.

Data concerning the concentration and specific activity of the liver and plasma in organic phosphates and phospholipids were obtained from adult white rats at intervals after the intravenous injection of 12 μc of dibasic sodium phosphate P^{32}; one group had previously received two daily subcutaneous injections of 0.1 mg of thyroxine/100 g body weight and the second group had received 0.1% of thiouracil in the drinking water for periods of 10-56 days. Because their specified activities have a constant relationship over a wide variety of experimental conditions, the authors state that the specific activity of the liver inorganic phosphates appears to be identical with that of the immediate phosphate precursor of the phospholipids of the liver; calculations based on this assumption indicate that the rate of phospholipid turnover in the liver is increased in rats which have received thyroxine and decreased in rats which have been treated with thiouracil. The rate of turnover of the phospholipids of the plasma also appears to be greater than normal in thyroxine-treated rats and less than normal in those receiving thiouracil; the rate of phospholipid turnover in the liver of young rats is essentially the same as that of mature rats greater in proportion to body weight. 15 references.

944 The Effects of Theiler's GD VII Virus on the Incorporation of Radioactive Carbon from Glucose into Minced One-Day-Old Mouse Brain. Max E. Rafelson, Jr., Richard J. Winzler, and Harold E. Pearson. J. Biol. Chem. 181, 595-600(1949) Dec.

Doses of 3 mg of C^{14}-containing glucose prepared synthetically were added to mixtures of Simms' solution and control and virus-infected minced mouse brain, and analyses were made of the tissue components after 24 hr of incubation.

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During the period of maximal virus propagation there was an increased incorporation of glucose fragments into the "protein" fraction and a decreased incorporation into the lipid fraction of virus-infected tissue, as compared with non-infected minces. Virus propagation had no influence on the relatively slower fixation of radioactive carbon dioxide into lipid and "protein" fractions.

945 The Effects of Theiler's GD VII Virus on P^{32} Uptake by Minced One-Day-Old Mouse Brain. Max E. Rafelson, Jr., Richard J. Winzler, and Harold E. Pearson. J. Biol. Chem. 181, 583-93(1949) Dec.

Flasks of a mixture containing 1 μc of P^{32} as inorganic phosphate, 2.5 ml of Simms' solution and 40-60 mg of weighed, minced brain tissue from one-day-old mice were prepared; Theiler's GD VII virus grown in minced mouse brain tissue was added in some cases to the flasks so that 0.03 ml of the supernatant solution was 50% lethal when injected intracerebrally into mice. A description is given of the methods of determination of the virus titer and the methods of fractionation of the tissue. The uptake of inorganic orthophosphate, the distribution of phosphorus in the various tricholoracetic acid-insoluble phosphate fractions of minced mouse brain and the effect of Theiler's GD VII virus propagation were studied. It was found that during the period of maximal rate of virus propagation the uptake of P^{32} was markedly stimulated in the phospholipid and "total proetin-bound" phosphate fractions; the increased turnover in the latter fraction is claimed to be primarily due to the increased turnover of ribonucleic acid phosphorus. Desoxyribonucleic acid was not affected. The virus-containing tissue had an increased ribonucleic acid-phosphorus content and a decreased desoxyribonucleic acid-phosphorus content.

946 External Measurement of Radio-Iodine in the Thyroid Gland. T. H. Oddie and R. Kaye Scott. Brit J. Radiology 22, 698-705(1949) Dec. (See also NSA 4-6.)

A detailed description is given of readily available Geiger counter apparatus for the external γ-ray measurement of radio-iodine in the thyroid gland. Calibration experiments with wax phantoms have enabled the system of measurement developed to be applied successfully to 13 test cases.

947 Fixation of Atmospheric CO_2 in the Dark by Leaves of Bryophyllum. John Thurlow and James Bonner. Arch. Biochem. 19, 509-11(1948) Dec. (Letter to the editor).

The proposition that the formation of carboxylic acids in the dark by excised leaves of succulents such as Bryophyllum may be due to fixation of CO_2 was investigated with the aid of $C^{14}O_2$. It was found that of the original radioactive CO_2 supplied to the leaves in these experiments, 23% was removed and fixed in the tissue; the dark fixation of the CO_2 was consequently shown to be large. After extraction of the leaves, it was found that more than half of the removed radioactivity was present in the washed mixed-acid fraction, containing mainly isocitric, citric, and malic acids; the residue containing cell wall materials, protein and other substances contained an appreciable activity also. It is con-

cluded that the formation of acids by the Bryophyllum in the dark continues for many hours and that this large scale fixation of CO_2 in the dark may be a quantitatively important m mechanism in the metabolism of this succulent.

948 The Incorporation of Acetate and Butyrate Carbon into Rat Liver Glycogen by Pathways Other Than Carbon Dioxide Fixation. Nathan Lifson, Victor Lorber, Warwick Sakami, and Harland G. Wood. J. Biol. Chem. 176, 1263-84(1948) Dec.

Rats were fasted for 24 hr, and then fed through a stomach tube a solution containing 1.7-3.3 mM of acetic or butyric acid labeled with C^{13} in the carboxyl carbon atom and 353-477 mg of glucose/100 g body weight. The rats were then placed in a metabolism chamber and their respiratory CO_2 was collected for three periods of 50 min each. The rat livers were examined and extracted and the glycogen was isolated and broken down to glucose; the latter was then degraded. It was found that all the excess isotopic carbon in the glycogen was present in positions 3 and 4 of the glucose unit, and, since these are the same positions as for CO_2 fixation and since considerable amounts of isotopic carbon appeared via the respiration, it is concluded that it is impossible to determine the presence of an additional pathway under these conditions. All degradation fractions of the fatty acids used contained excess C^{13}. This is considered direct evidence that at least the α-carbon atoms of acetate and butyrate can enter glycogen by a pathway other than CO_2 fixation. The distribution of the isotope found in liver glycogen is consistent with the formation of 3-carbon fragments via the tricarboxylic acid cycle. 25 references.

949 Incorporation of Carbon-labeled Formic Acid and Carbon Dioxide into Hypoxanthine in Pigeon Liver Homogenates. G. Robert Greenberg. Arch. Biochem. 19, 337-9(1948) Nov. (Letter to the editor).

The results of experiments demonstrating the synthesis of a purine in essentially cell-free pigeon liver homogenates by the incorporation of labeled formate and bicarbonate into hypoxanthine are reported here. The net formation of the hypoxanthine as measured spectrophotometrically with xanthine oxidase was found to be larger in some cases than that calculated from the C^{14} formate incorporated into the purine; it is suggested that this difference could arise from concomitant breakdown of nucleic acid fragments, or by the synthesis of hypoxanthine from unlabeled endogenous precursors. It is also suggested that the C^{14} incorporation may proceed slower anaerobically than aerobically, while the total formation of hypoxanthine does not vary significantly; 0.001M adenosine triphosphate was found to inhibit the C^{14} incorporation; the effect of related compounds such as muscle adenylic acid or adenosine was not tested. Pigeon liver mince did not bring about more incorporation than did the cell-free homogenate. This system is being employed to study the intermediate synthesis reactions of hypoxanthine and to follow the metabolism of the compound.

950 The Initial Uptake of C^{14}-Labelled Methadone by Rat Tissues. T. K. Adler and L. L. Eisenbrandt. Proc. Soc. Exptl. Biol. Med. 72, 347-9(1949) Nov.

In order to determine the rate and effect of the accumulation of methadone on the rat liver, brain, kidneys, peripheral nervous system, and blood, a 10 mg/kg dose of C^{14}-labeled methadone HBr was given subcutaneously to each of eight young adult rats of the Slonaker-Wistar strain. After 10, 20, 30, or 40 min one male and one female were sacrificed. It was found that methadone makes its appearance in the blood within 10 min after a subcutaneous injection; the methadone was confined to the plasma. There was no activity in the cerebrum until about 10 min after administration of the methadone, and the concentration remained low, indicating no special affinity of the methadone for the brain; the adrenals and the liver accumulated the drug at a high rate, but there was no activity in the sciatic nerve during the period studied.

951 The in Vitro Synthesis of Cholesterol from Acetate by Surviving Adrenal Cortical Tissue. Paul A. Srere, I. L. Chaikoff, and W. G. Daubin. J. Biol. Chem. 176, 829-33(1948) Nov.

Five hundred mg of adrenal cortex slices of fresh beef glands were incubated with 0.5 cc of 0.024 N $C^{14}H_3C^{14}OONa$, having 940,000 counts/min/cc², in air for a period of 3 hr. At the end of the incubation period a procedure, which is described, was begun to isolate the cholesterol and the fatty acids from the mixture and record the radioactivity of the components. It was found that a conversion of the labeled acetate to cholesterol occurred by means of the surviving beef cortex slices; a constant specific activity was observed for the cholesterol and its two derivatives, digitonide and acetate.

952 Ketone Body Formation from Tyrosine. Sidney Weinhouse and Ruth H. Millington. J. Biol. Chem. 181, 645-53(1949) Dec.

When tyrosine, labeled with C^{14} in the β position, was incubated with liver slices of the rat, it was found to be converted to acetoacetate labeled predominantly in the α position. These results, in conjunction with those of other investigations, indicated to the authors that this conversion may proceed through the intermediate steps of p-hydroxyphenylpyruvic and homogentisic acids; the reaction is comparatively slow, and is not accompanied by other metabolic reactions of tyrosine involving the complete oxidation of the β carbon.

953 The Metabolism of Arterial Tissue. II. Lipide Syntheses: the Formation in Vitro of Fatty Acids and Phospholipides by Rat Artery with C^{14} and P^{32} as Indicators. S. Chernick, Paul A. Srere, and I. L. Chaikoff. J. Biol. Chem. 179, 113-18(1949) May.

The synthesis of lipids by the rat thoracic aorta was investigated with the aid of P^{32} and acetic acid in which both carbons were labeled with C^{14}. It was found that the fresh artery is capable of converting acetate to fatty acids; the incorporation of P^{32} into the phospholipid molecule is also readily accomplished by the rat artery. The significance of these results on the development of atherosclerosis is discussed. 13 references.

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954 Metabolism of Estradiol Labeled with Radio-Iodine in Normal and Tumor-bearing Mice. S. Albert, J. Cohen, R. D. H. Heard, and C. P. Leblond. Acta Unio Intern. contra Cancrum 6, 568-70(1949). (See also NSA 4-593.)

In the first of a series of screening experiments the distribution of radio-iodoestradiol (RID), labeled with I^{131}, 10-12 hr after its subcutaneous injection was studied in all the tissues and organs of normal and tumor-bearing A and C3H mice. It was found that most of the compound was rapidly excreted in the gastrointestinal tract feces and urine; fairly large amounts were found in the mammary glands, but only minute amounts in the other accessory sex organs, endocrine glands and mammary tumors; there was no apparent strain difference nor any marked difference between tumor-bearing and normal mice of the C3H strain. In the second series of experiments, the effect of bile duct ligation on the metabolism of RID was investigated and it was concluded that the main channel of excretion of this compound was the bile. In a third series of experiments, the effect of intragastric instillation of the compound upon its metabolism was studied and it was found that some of the compound was absorbed as an iodinated steroid, while much of it was destroyed and the iodine liberated in greater amounts than ordinarily. The fractionation of various organs suggested that the I^{131} found present was received as a phenolic steroid. Preliminary studies demonstrated that the iodination of estradiol destroyed its estrogenic activity.

955 On the Absorption of Phospholipides. Camillo Artom and Marjorie A. Swanson. J. Biol. Chem. 175, 871-81 (1948) Sept. (See also NSA 4-584.)

Labeled phospholipids (prepared from the livers of animals injected with radioactive phosphates) were fed to two rats by stomach tube. After 3 or 6 hr the radioactivity and the phosphorus content were determined in various fractions of the plasma and the liver; the results were compared with those obtained on control rats receiving nonlabeled phospholipids and P^{32} as $Na_2HP^{32}O_4$ (or glycerophosphate). The authors authors state that it appears that phospholipids may be absorbed at various stages of hydrolysis, and while part of the phospholipids are split in the gastrointestinal tract, so that the phosphate radical is absorbed in inorganic form, it is stated that there is also definite evidence that a detectable portion of the ingested phospholipids can be absorbed as the intact molecule. 31 references.

956 Oxidation of Glucose Labeled with Radioactive Carbon by Normal and Alloxan-Diabetic Rats. D. B. Zilversmit, I. L. Chaikoff, D. D. Feller, and E. J. Masoro. J. Biol. Chem. 176, 389-400(1948) Oct.

Normal and alloxan-diabetic rats received intraperitoneally 100 mg of glucose labeled with C^{14} or 1 gm/kg of body weight of the radioglucose intravenously, in order to trace the conversion of glucose to CO_2 under normal and diabetic conditions. Nephrectomized normal and nephrectomized alloxan-diabetic rats were also tested for their ability to convert the radioglucose to CO_2. It was found that $C^{14}O_2$ appeared in the exhalations of the rats within 30 min and that the diabetic animals from the first experiment excreted more of the

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administered glucose in the urine than did the normal rats. Since the $C^{14}O_2$ exhalation provided no basis for judging the oxidizing powers of the animals, the second experiment was performed; the rats were injected with the radioactive glucose 15 min after nephrectomy and it was found that there was no difference in the amount of $C^{14}O_2$ exhalation in the normal and diabetic rats. It is concluded that the plasma glucose appears to be utilized and converted to CO_2 at the same rate in the normal and the alloxan-diabetic rat. 15 references.

957 Oxidation in Vivo of Emulsified Radioactive Trilaurin Administered Intravenously. Robert P. Geyer, June Chipman, and F. J. Stare. J. Biol. Chem. 176, 1469-70(1948) Dec. (Letter to the editor).

The rate of metabolism in vivo of emulsified fat injected intravenously in a dog was studied by administering trilaurin containing lauric acid labeled with C^{14} in the carboxyl group. A typical experiment on a nonfasted female rat is described; the rat was injected intravenously through the tail vein with 3.9 ml of a 20 ml solution containing 0.4 g of the radioactive trilaurin, and the animal was immediately placed in a respirometer chamber and serial samples of expired CO_2 were collected in NaOH. From the data it is concluded that properly emulsified fat is utilized immediately for energy following its intravenous administration.

958 Photosynthesis in Plants. A Monograph of the American Society of Plant Physiologists. James Franck and Walter E. Loomis, Eds. Ames, Iowa State College Press, 1949. 500p.

This monograph covers 22 chapters contributed by 32 authors on different phases of the topic of photosynthesis. The book includes discussions on world totals of photosynthesis, limiting factors, products, absorption of CO_2, chloroplasts, chloroplast pigments, chlorophyll action, structure, and formation; comparative biochemistry and the photosynthetic process and fluorescence of chlorophyll and plants are also discussed. Five chapters are included which discuss the mechanism and intermediate products of photosynthesis as measured by metabolic changes and with C^{13} and C^{14} tracers.

959 Plasma Levels of Radioactive Iodine (I^{131}) in Human Tracer Studies. Hilda S. Rollman and W. Petit. Proc. Soc. Exptl. Biol. Med. 72, 474-6(1949) Nov.

The post ingestion plasma iodine curves in 25 euthyroid, hypothyroid, and hyperthyroid subjects were investigated through the use of I^{131}; doses of 100 μc of the I^{131} were given and the curves were constructed from plasma samples drawn at 30 min and at 1, 3, 6, 12, 24, and 48 hr. It was found that it was impossible to separate the curves of the hyperthyroid patients from those of the euthyroid; the curves of the myxedematous (hypothyroid) patients, however, showed significant differences, demonstrating a later peak level, a lower peak level and a more delayed fall than the other curves.

960 Radioactivity and Biochemistry. Anon. Chem. Age (London) 61, 803(1949) Dec. 10.

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Decisive events and milestones in the development of radioactive isotopes and their use in biochemistry, and the growth of atomic physics were reviewed at the anniversary meeting in London of the Royal Society by the president Sir Robert Robinson. Special emphasis was placed upon the work of George C. de Hevesy on the chemistry of radioactive elements and their use as biological tracers.

961 Radioiodine Uptake Curve in Humans. II. Studies in Children. George H. Lowrey, William H. Beierwalters, Isadore Lampe, and Henry J. Gomberg. Pediatrics 4, 627-33(1949) Nov.

The rate of uptake of radioiodine by the thyroid gland was measured in a series of 26 children, 14 of which were abnormal. The tracer used was I^{131} and it was administered orally as sodium iodide in doses of 20-50 μc, depending on the age of the child, after an 8 hr fast period; traces of the isotope were washed from the esophagus by tracer-free water, and counts were begun within 10 min and continued at intervals of 5-20 min for the first 2 hr. The curves of 12 of the abnormal patients deviated from those of the normal group; those patients with thyroid dysfunction were divided into three classes; hypofunction, hyperfunction, and colloid goiter. The authors conclude that this method appears to be valuable as a diagnostic tool in estimating the relative degree of thyroid function. 20 references.

962 Rates of Turnover and Biologic Decay of Chloride and Chloride Space in Dogs Determined with the Long-Life Isotope, Cl^{36}. G. E. Burch, S. A. Threefoot, and C. Thorpe Ray. J. Lab. Clin. Med. 34, 1589(1949) Nov.

With the aid of Cl^{36}, a study was made of the early concentration-time course in the blood serum, biologic decay rates, and rates of turnover of chloride in six normal dogs observed continuously for 18-31 days under controlled metabolic conditions. A multiple exponential equation is presented which expresses the mean concentration-time course of the isotope in serum 60 min after intravenous administration. It was found that all the seral chloride leaves the serum every minute and about one-third of the nonseral chloride returns each minute; the mean $C_{\frac{1}{2}}$ value for the serum, the mean recovery, and the mean chloride space were determined. These and other data indicate that: the chloride space is larger than previously reported; the chloride cannot be employed as a measure of the extracellular fluid space; chloride is present in considerable quantities outside the extracellular fluids; and, due to the difference in the sodium intake and utilization by weight between man and small animals, such as the dog, studies of low sodium metabolism in such animals with "hypertension" must be cautiously evaluated. The importance of these studies in planning experiments involving chloride and bromide action and metabolism is stressed.

963 Serum Level of Protein Bound Radioactive Iodine (I^{131}) in the Diagnosis of Hyperthyroidism. A. Stone Freedberg, Alvin Ureles, and Saul Hertz. Proc. Soc. Exptl. Biol. Med. 70, 679-82(1949) Apr.

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The serum protein bound radioactive iodine (I^{131}) level was determined by a modification of the method of Chaikoff et al (Endocrinology 40, 47(1947)) 24 hr after the oral administration of 150 mc of I^{131} to each of 20 human subjects; ten of the subjects were thyrotoxic and the rest were euthyroid. It was found that the serum protein bound I^{131} level was 0.00038-0.00146 μc/cc for the thyrotoxic patients, with an average value of 0.00068 μc/cc; the euthyroid patients had a serum level of 0.00003-0.00028 μc/cc, with an average of 0.00013 μc/cc. It is concluded that this test may be of diagnostic value as a measure of thyroid function.

964 Some Aspects of the Metabolism of Pyruvic Acid in the Intact Animal. H. S. Anker. J. Biol. Chem. 176, 1337-52(1948) Dec. (See also NSA 4-620 and 4-676.)

Carbonyl- and carboxyl-labeled pyruvic acids and carboxyl-labeled acetic acid (utilizing C^{14}) were synthesized and fed to two strains of rats (Sprague-Dawley and laboratory mixed). Acetyl derivatives of p-aminobenzoic and γ-phenylaminobutyric acids were extracted from the urine; glycogen, cholesterol, and fatty acids were isolated from the liver, and cholesterol and fatty acids from the carcass. It was noted that in the Sprague-Dawley strain conversion of pyruvic acid to acetic acid seemed to occur; in the laboratory strain (mixture of Wistar and Sprague-Dawley rats) this was not observed. It was also observed that pyruvic acid was not in equilibrium with dietary carbohydrate, and acetic acid contributed a larger number of carbon atoms to the fatty acids than pyruvic acid. It is claimed that the utilization of pyruvic acid as a precursor for cholesterol is small. 28 references.

965 Some Observations on Alcohol Metabolism with Radioactive Ethyl Alcohol. Grant R. Bartlett and Harry N. Barnet. Quart. J. Studies Alc. 10, 381-97(1949) Dec.

The rate of combustion of alcohol in the normal rat and in the rat habituated to alcohol in the diet, the influence of pyruvate on alcohol combustion in the rat, the rate of alcohol oxidation in various tissues, in vitro, of normal and alcohol-habituated rats, and the influence of pyruvate on alcohol oxidation in rat tissue slices were investigated in the experiments reported here. All of the experiments entailed the use of C^{14} labeled alcohol, the radioactivity acting as a tracer for the metabolism; complete combustion of the alcohol to CO_2 was measured in all cases. It was found that following a 1 g/kg oral dose there was no acceleration of complete alcohol oxidation in the alcohol-habituated rats or in the animals receiving pyruvate. In the in vitro experiments the liver and kidney showed rapid oxidation while the brain showed none; no stimulation of oxidation occurred in the liver through the addition of pyruvate. 38 references.

966 Studies of Acetoacetate Formation with Labeled Carbon. I. Experiments with Pyruvate, Acetate, and Fatty Acids in Washed Liver Homogenates. Dana I. Crandall and Samuel Gurin. J. Biol. Chem. 181, 829-43(1949) Dec.

Several radioactive substances (acetate labeled with C^{13} in the carboxyl group, pyruvate labeled with C^{13} or C^{14} in the α and

β positions, and C^{13}-carboxyl- and β labeled octanoate and hexanoate) were incubated in washed homogenates of rat liver; the concentrations of CO_2 and acetoacetate produced during the reaction process were observed. It was found that the evolved CO_2 was unlabeled and the acetoacetate contained equal concentrations of isotope in the carboxyl and acetone carbons when α,β pyruvate was incubated; these results, it is claimed, verified the conclusion that the α and β but not the carboxyl carbons of pyruvate enter into the biosynthesis of acetoacetate. Octanoate also stimulated the conversion of acetate to acetoacetate, but an asymmetrically-labeled acetoacetate was produced from carboxyl-labeled acetate; both carboxyl- and β-labeled octanoate gave rise to acetoacetate containing more C^{13} in the carboxyl position than in the carbonyl position. In the presence of octanoate, pyruvate and acetate showed a similar tendency to introduce their carbons preferentially into the carboxyl portion of acetoacetate and in this respect were similar to the 2-carbon fragments which arose from the first 4 carbons of octanoate. A hypothesis that fatty acids give rise to more than one type of 2-carbon intermediate in the process of forming acetoacetate is proposed as an explanation for the uneven distribution of isotope in the acetoacetate formed from both carboxyl- and β-labeled octanoate. 24 references.

967 Studies of Acetoacetate Formation with Labeled Carbon. II. The Conversion of ζ-(C_7)-labeled Octanoate to Acetoacetate. Dana I. Crandall, Roscoe O. Brady, and Samuel Gurin. J. Biol. Chem. 181, 845-52(1949) Dec.

The incubation of ζ-octanoate acid (labeled with C^{14} in the carbon 7 position) with the washed homogenate of rat liver resulted in the formation of predominantly carbonyl-labeled acetoacetate; simultaneous incubation of nonlabeled pyruvate with the ζ-labeled octanoate did not alter the distribution of isotope in the resulting acetoacetate. It is concluded that these experiments demonstrate that fatty acids upon oxidation by liver give rise to two species of 2-carbon units in the process of forming acetoacetate; one species not readily acetylated is derived from the ζ- and ω-carbons of octanoate, while the other species arises from the first 6 carbon atoms of octanoate. The possibility that pyruvate and acetate may form 2-carbon units identical with those from 6 carbons of octanoate is discussed.

968 Studies on Globin and Porphyrin Metabolism Made with C^{14} and N^{15}. Moises Grinstein, M. D. Kamen, and Carl V. Moore. J. Lab. Clin. Med. 33, 1478-9 (1948) Nov.

Glycine labeled with C^{14} in the carboxyl group was fed to two dogs and to one rat; in each instance, the C^{14} appeared in the globin portion of hemoglobin but could not be demonstrated in the heme. The concentration in globin rose rapidly in the dogs during the first few days, remained relatively constant until the 65th and 80th days, respectively, and then fell to very low levels. The results indicated that the globin of intact erythrocytes remained within the cell during its life span without participating in the dynamic protein interchange characteristic of nucleated cells and was apparently not utilized again for new hemoglobin formation once the cell

was destroyed. In the second series of experiments, 5.6 g of glycine tagged with 27.7% excess N^{15} was fed to one dog which had previously been made anemic by bleeding; crystalline protoporphyrin 9 was isolated from blood taken at intervals during the following 34 days and was found to be tagged. Coproporphyrin I with a high percentage of the isotope was also demonstrated up to 20 days after the isotope feeding. On the 34th day after the feeding the animal was bled to death and the total volume of red blood cells was introduced into a second anemic animal. Crystalline protoporphyrin 9 with radioactivity and, after acute anemia induction, coproporphyrin I with no radioactivity were isolated. It is stated that the data suggest that coproporphyrin I is formed as a by-product during the biosynthesis of hemoglobin and is not derived from hemoglobin catabolism; the excreted protoporphyrin 9 might, in phenylhydrazine anemia at least, be a derivative of hemoglobin degraded during the hemolysis. Free erythrocyte protoporphyrin of the blood cells is suggested as another possible source of the fecal protoporphyrin 9.

969 Studies on the Metabolism of Radioactive Nicotinic Acid and Nicotinamide in Mice. Lloyd J. Roth, Edgar Leifer, John R. Hogness, and Wright H. Langham. J. Biol. Chem. 176, 249-57(1948) Oct.

The part of this material concerned with the experiments and results of the investigation of radioactive nicotinic acid appeared previously as MDDC-1534. The metabolism of nicotinamide was also investigated through the use of compounds tagged with C^{14} in the carboxyl group. Radionicotinamide (0.7 g/animal or 50,000 counts/sec) was injected intraperitoneally in a set of nine mice and the animals were transferred to a metabolism cage. Urine, feces, and CO_2 were collected at various intervals and the C^{14} activity was determined. A second series of mice were injected with both radionicotinic acid and radionicotinamide and the animals were sacrificed at intervals for the purpose of tissue analysis. It was found that of the radioactivity fixed in the tissues about 15% of the C^{14} appeared as exhaled CO_2. Decarboxylation of the nicotinamide occurred; of the metabolites isolated, all contained a carboxyl group in the 3 position of the pyridine ring. It is concluded that the gross metabolisms of nicotinic acid and nicotinamide are identical in the mouse.

970 Studies on the Phosphorus Metabolism of Green Algae and Purple Bacteria in Relation to Photosynthesis. Howard Gest and Martin D. Kamen. J. Biol. Chem. 176, 299-318(1948) Oct.

The uptake and turnover of phosphate in various cell fractions influenced by light was investigated by the use of two species of Chlorococcales (Chlorella pyrenoidosa, Scenedesmus D_3) and a species of Athiorhodaceae (Rhodospirillium rubrum), and with the aid of P^{32}. It was shown that the gross phosphate distribution may be altered considerably by experimental conditions prior to the analysis of the organisms; the phosphate uptake was considerably greater in the light than in the dark for all of the organisms examined. It was indicated that the cellular phosphate turnover and equilibration with exogenous phosphate are mediated by a small fraction of the soluble cellular phosphate. 29 references.

971 Studies with Radioactive Carbon-labeled Acetate on Cholesterol Metabolism in Rats Fed P-Dimethylaminoazobenzene. Carl G. Baker and David M. Greenberg. Cancer Research 9, 701-6(1949) Dec.

Subcutaneous injections of radioactive carboxyl-labeled acetate were given over a period of five days to normal rats and to rats bearing butter yellow-induced hepatomata for total dosages of 4960 counts/min/g of body weight; labeled cholesterol was isolated from various individual whole organs by the digitonide method. It was found that in both groups the cholesterol activity was the same but the percentage of cholesterol present in the liver was greater for the tumor-bearing group; the adrenal tissue showed the greatest ability to make cholesterol. The coprosterol and dihydrocholesterol digitonides were also found to be radioactive; a discussion of the occurrence of a lung tumor in one of the test rats is also presented. 36 references.

972 Studies with Radioactive Iodine on Certain Functions of Benign and Malignant Tumors of the Thyroid. Rulon W. Rawson, Brown M. Dobyns, Ruth Hill, and Rex G. Fluharty. Acta Unio Intern. contra Cancrum 6, 831-43(1949).

Studies with radioactive iodine I^{131} were performed in determining the iodine collecting capacities of normal and tumorous thyroid tissue, the relation of tumorous function to cellular patterns, the effect of total thyroidectomy on the iodine concentrating ability of metastatic tumors arising from the thyroid, and the difference in the effects of thiouracil on tumerous and normal thyroid tissue. The I^{131} was administered one to seven days before thyroidectomy to 21 patients with cancer of the thyroid and to 23 patients with benign tumors of the thyroid in doses of 100-2,000 μc with 3-200 μg of carrier iodine. The results of the study of the excised thyroid tissue indicate that benign tumors of the thyroid have the capacity to concentrate iodine, but usually to a lesser degree than normal thyroid tissue; the degree of avidity of these benign tumors roughly parallels the degree of differentiation of the cells. The capacity of malignant tumors of the thyroid to collect iodine is minimal or absent; the capacity of metastatic lesions arising from thyroid cancers was increased significantly in certain cases by removing the thyroid. Thiouracil was observed to exert much less block to the collection of iodine by functioning thyroid cancer tissue than by normal thyroid tissue.

973 Studies with a Radioactive Spinal Anaesthetic. Frank Howarth. Brit. J. Pharmacol. 4, 333-47(1949) Dec. (See also NSA 3-624.)

Studies determining the fate of a radioactive spinal anesthetic with special reference to its ultimate distribution among the tissues of the body and the route by which it leaves the spinal theca are presented. Procaine was brominated with the isotope Br^{82}; the dibromoprocaine hydrobromide ($C_{13}H_{18}Br_2N_2O_2.HBr$) or DBP hydrobromide was converted to DBP hydrochloride. Cats and monkeys were the subjects of these experiments. It was found that after the intrathecal injection of the drug, the concentration in the spinal subarachnoid space rapidly declined; a rapid rise in urine concentration was associated with this, while the blood level remained persistently low. After

intrathecal injections of DBP, only the spinal roots regularly showed any capacity to concentrate the drug above the level existing in the cerebrospinal fluid at the site of injection. Of the tissues examined, only the kidney (and urine) and liver (and bile) appeared to be able to concentrate DBP above the circulating blood concentration; large variations in time and dose did not produce large changes in the tissue/blood ratios. The drug was found to enter the spinal cord during spinal anesthesia; in the cat the venous system is concluded to be the most important mode of departure.

974 A Study of the Metabolism of Dietary Hypoxanthine and Xanthine in the Rat. Helen Getler, Paul M. Roll, John F. Tinker, and George Bosworth Brown. J. Biol. Chem. 178, 259-64(1949) Mar.

Hypoxanthine and xanthine, each labeled with isotopic nitrogen N^{15} in the 1 and 3 positions, were prepared by the deamination of labeled adenine and guanine; labeled hypoxanthine was also synthesized independently. Hypoxanthine was fed to rats in two experiments, at levels of 26 and 200 mg/kg body weight per day, and the xanthine was fed at a level of 105 mg/kg body weight per day to rats. It was found that both hypoxanthine and xanthine when fed in diets were ineffective as precursors of nucleic acids in the rat but were extensively converted to allantoin. 21 references.

975 Thyroglobulin Formation in the Thyroid Follicle Visualized by the "Coated Autograph" Technique. C. P. Leblond and J. Gross. Endocrinology 43, 306-24(1948) Nov.

The entry of radioactive iodine into the thyroid was observed by means of the autographic technique in the thyroids of animals kept under the following conditions: rats on a low iodine intake; rats receiving about 22 μg of iodine daily; hypophysectomized rats on a low iodine intake; and, guinea pigs receiving thyrotrophic hormone. The autographic reactions were shown to be due to radioiodine present as thyroglobulin. In the animals which received 22 μg of nonradioactive iodine daily, the radioactivity was mostly present in the epithelium at 1 hr, and in the colloid at 24 hr after injection; in the iodine-deficient group, the deposition of radioiodine into the colloid was much accelerated, since it was found there as early as 2 min after injection. A rapid deposition is also found in the thyrotrophin-treated animals; in the hypophysectomized group, the deposition of radioactivity into the colloid is depressed, since the radioactive material is still present in the cells at 24 hr after injection. It is stated that these results indicate that thyroglobulin is formed in the cells and is released into the colloid, this sequence being most rapid in active thyroids and slow after hypophysectomy. All follicles in any gland are active at all times in fixing iodine but variable in activity. From the data presented, it is concluded that it seems likely that circulating iodide is continuously bound to protein (i.e., thyroglobulin) in the cytoplasm of the thyroid cell; this thyroglobulin is continuously deposited in the colloid of the thyroid follicle. 49 references.

976 Tracer Studies Concerning the Influence of Hormones on the Passage of Ions Through Living Membranes.

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Hans H. Ussing. Acta Unio Intern. contra Cancrum 6, 857-68(1949).

Experiments were undertaken to study the passage in and out of ions through the skin of the axolotl. The method consisted in keeping the experimental animals in dilute salt solutions containing minute amounts of radioactive tracers, usually Na^{24}. The action of various agents like insipidin (salt uptake +) and pitupartin (salt lost +) were tested. Adrenalin has been found to increase the salt loss of the isolated skin; the mechanism of this action is discussed and an hypothesis to explain the results is proposed.

977 The Turnover Rates of Plasma Lecithin and Plasma Sphingomyelin as Measured by the Disappearance of their Radioactive Phosphorus from the Circulation. D. B. Zilversmit, C. Entenman, and I. L. Chaikoff. J. Biol. Chem. 176, 209-12(1948) Oct. (See also NSA 4-608.)

Radioactive phospholipids were obtained from the plasma of a donor dog that had received orally 4 mc of P^{32} 24 hr before exsanguination and were injected in 100 cc of plasma into each of three recipient dogs; the rates of disappearance of the lecithin and the sphingomyelin from the circulation were recorded. A subsequent experiment involved the injection into the same recipient dogs of the blood from a donor dog that had received 4 mc of P^{32} 48 hr before being bled. Since it was found that the turnover times for plasma lecithin were shorter than that of plasma sphingomyelin even though the plasma of the dogs contained 4-5 times as much of the former as the latter, it is concluded that the plasma lecithin turnover rate is about five times as great as that of the plasma sphingomyelin.

978 2,6-Diaminopurine, a Precursor of Nucleic Acid Guanine. Aaron Bendich and George Bosworth Brown. J. Biol. Chem. 176, 1571-2(1948) Dec. (Letter to the editor). (See also NSA 4-677.)

The compound 2,6-diaminopurine was synthesized with N^{15} in the 1 and 3 positions of the ring and in the 2 amino group; it was administered by stomach tube to rats at a level of 29 mg/kg/day for three days and the urinary constituents and total nucleic acids of the viscera were examined. The results showed that 2,6-diaminopurine and adenine are more toxic than other purines and that the former evidences apparent "antipurine-metabolite" behavior. The results also indicated that 2,6-diaminopurine is an effective precursor of nucleic acid guanine.

979 The Utilization of Glycine for the Biosynthesis of Both Types of Pyrroles in Protoporphyrin. Jonathan Wittenberg and David Shemin. J. Biol. Chem. 178, 47-51(1949) Mar.

A solution of glycine containing 32 at.% of excess N^{15} was injected intraperitoneally into two ducks; a total of 1.5 g was administered in four injections spaced over a period of two days. The birds were killed 12 days later, and from the pooled blood, the hemin was isolated. A similar experiment was performed on a woman with polycythemia vera who consumed at frequent intervals over a period of two days

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48 g of glycine labeled with the same per cent of excess N^{15}; sample blood was withdrawn 16 and 30 days after the start of the experiment and the hemin was isolated. The labeled hemin was degraded in order to study the isotope concentrations of the nitrogen atoms in the pyrrole structures of the porphyrin. The N^{15} concentrations were found to be equal in the porphyrin, in the methylmethoxyethylmaleimide and in the hematinic acid. It is concluded that these data show that glycine is the precursor for both types of pyrroles in the protoporphyrin molecule.

980 Your Crop Versus Phosphorus. E. F. Wallihan. Calif. Citograph 34, 116-17, 120-21(1949).

A general discussion is presented concerning the phosphorus problem; the use of radioactive isotopes in a study of this problem is described.

981 Atom Bomb Cataracts. David G. Cogan, S. Forrest Martin, and Samuel J. Kimura. Science 110, 654-5 (1949) Dec. 16.

Preliminary results are given of a survey, undertaken under the auspices of the Atomic Bomb Casualty Commission of the National Research Council, to determine the ocular effects of the atomic bombings in Japan. Ten cases of cataracts are described which are believed to have been caused by exposure to intense radiations. All ten patients had normal vision prior to exposure, and were within 550 to 950 m of the hypocenter at the time of the explosion. The latent period of visual symptoms ranged from 6 months to 2½ years, while the failure of vision was either gradual or stepwise and fluctuant. A detailed ophthalmological description of the cataracts is given. They are considered similar to those which have previously been associated with exposure to γ rays and x-rays, and the role of neutrons in their pathogenesis was not established.

982 The Behaviour of the Tumor Cell under the Influence of Irradiation and Chemicals. P. C. Koller. Acta Unio Intern. contra Cancrum 6, 812-15(1949).

The permanent and temporary effects induced in tumors cells by irradiation with doses of 200-600 r are described. The temporary changes comprise the suppression of cell division and the various physiological effects such as stickiness or clumping of chromosomes and abnormal or incomplete spindle formation during mitosis; the permanent effects induced by irradiation consist of visible changes in the chromosome structure. The chromosome injuries consist mostly of fragmentation; the fragments become acentric and are excluded from the daughter nuclei; their number varies with the dose. It is stated that evidence accumulated in recent years indicates clearly that irradiation produces direct changes in the cytoplasm which affect the nucleus. Irradiation indirectly affects the tumor cells by increasing the stroma reaction (invasion of plasma cells into the connective tissue surrounding the tumor) and depleting the food supply to the tumor, with consequent uniform degeneration; the rate and the type of stroma reaction present depends on the method of fractionation of the dose. Similar injuries can be induced in tumor cells by such chemicals as the nitroge-

nous mustards; permanent damage in the cells is produced during mitosis, and it is suggested that the chromosome injuries induced occur in all cells undergoing cellular division at, or a few hours after, the introduction of the chemical.

983 The Biologic Effects of High Energy Roentgen Rays. Henry Quastler. Acta Unio Intern. contra Cancrum 6, 825-30(1949).

The results of an investigation to determine the specific effects of high energy roentgen rays, the qualitative efficiency of such rays and whether the efficiency of the rays varies with regard to different reactions are reported. A clinical and histological study of mice irradiated with 20-Mev roentgen rays, and other investigations on many plant seedlings irradiated with high energy indicated that no specific effect of high energy rays could be found. The survival time of irradiated mice, the greying of hair in mice, the stunting of growth in beans and the sex-linked mutations in Drosophila were some biologic tests used in reaching the conclusions that the biologic efficiency of high energy photons is roughly three-fourths that of conventional roentgen rays, if both doses are measured and referred to the 25 r thimble chamber of an ionmeter. Biologic investigations undertaken to determine whether the differences found in the factor of equivalence are due to random sampling or to actual differences indicated that the qualitative effectiveness of the high energy rays seems to vary slightly with regard to various biologic reactions. It is concluded that the main advantage of this type of ray will reside in the possibility of administration of optimum tumor doses anywhere within the human body without skin burns and without very severe systemic reactions.

984 The Changes Induced in Iodine Metabolism of the Rat by Internal Radiation of Its Thyroid with I^{131}. D. D. Feller, I. L. Chaikoff, Alvin Taurog, and Hardin B. Jones. Endocrinology 45, 464-79(1949) Nov.

A total of 100 adult male rats of the Long-Evans strain were injected intraperitoneally with either 24, 30, 300, or 875 μc of carrier-free I^{131}, and were sacrificed at 1, 2, 3, 6, 8, or 10 days thereafter. A method for estimating the dose, in rep delivered to the center and to a point near the surface of the small rat thyroid gland, is presented. The following criteria were used as indicators of metabolic changes induced in the thyroid glands by the internal radiation of the injected I^{131}: (1) the concentration of protein-bound iodine in plasma, (2) the chemical iodine content of the gland, (3) retention of the initial injection of I^{131} by the gland, and (4) the capacity of the irradiated gland to concentrate a second injection of I^{131}. In addition, all glands were examined histologically. Following the injection of 875 μc of I^{131}, a triphasic response in plasma protein-bound iodine was observed: an initial decrease occurred 24 hr after the injection, at which time 150,000 rep had been delivered to the center of the gland; this initial response was followed by a sharp rise in the level of plasma protein-bound iodine; the third response consisted of a reduction in plasma iodine to thyroidectomy levels. The injection of 300 μc of I^{131} decreased the concentration of protein-bound iodine in plasma,

but no subsequent rise in plasma iodine was observed. A change in the iodine (I^{127}) content of the thyroid gland was not observed until two days after the injection of either 300 or 875 μc of I^{131}; by the eighth day, the gland's iodine was practically depleted. The percentages of the initially injected I^{131} present in the gland one day after the injection of 300 or 875 μc of I^{131} were the same as those observed in rats injected with 24 μc. At the end of two days, however, the thyroid glands of rats which had received 300 or 875 μc, respectively, failed to retain the trapped iodine to the same extent as did the glands of rats that had received 24 μc. This 48-hr interval corresponds to the time when the chemical iodine was being rapidly lost from the strongly irradiated glands. Rats were treated twice with 300 μc of I^{131}; the irradiated glands collected about one-tenth the amount of I^{131} found in the glands of the control (untreated) group. As judged by the metabolic criteria outlined above, it is concluded that the thyroid function is not disturbed in the rat up to 10 days after the injection of 24 or 30 μc of I^{131}.

985 A Comparison of the Radiosensitivities of Tumors Autogenous to Inbred Strains of Animals. Anna Goldfeder. Acta Unio Intern. contra Cancrum 6, 787-93(1949). (See also NSA 2-1698.)

The results of some experiments designed to classify tumors grown in inbred strains of animals autogenous to their respective strains according to their radiosensitivity and immunizing ability are presented. It was demonstrated in previous experiments that tumor implants, attenuated with doses of radiation within a specific range, which failed to produce a tumor, rendered the animal resistant to fresh viable tumor grafts upon reimplantation; this was demonstrated in mouse sarcoma 180 and on a reticulum cell-type lymphosarcoma. In the present experiments fragments of about 5 cu mm of two mammary adenocarcinomas, designated as C3H and dba, were exposed to radiation at 12.5 cm distance from a 200 kv Coolidge tube, with a 0.5 mm Cu and 1 mm Al filtration; the average intensity was 604 r/min and the dose was applied in a single exposure; doses of 20,000-130,000 r are discussed. Following the radiations the tumor tissues were placed in a nutrient culture medium and studied at each 24 hr incubation period for 7 to 9 days. The two tumors were found to differ widely in their radiosensitivity, the threshold dose for the C3H tumor being 2,600-2,800 r/air while that for the dba tumor was 4,500-4,800 r/air. It is concluded that a distinctive relationship appears to exist in various tumors between their radiosensitivities and their grades of differentiation following irradiation, even among analogous tumors, such as were studied.

986 A Comparison of the Reaction of Cells to Nitrogen Mustard and X-rays. Robert Schreck. Acta Unio Intern. contra Cancrum 6, 848-56(1949).

The reactions of nitrogen mustard (methyl bis B-cholroethyl amine hydrochloride) and x-rays on cells from rabbit thymus and bone marrow and on human blood cells in suspension were studied by the method of unstained cells counts and dark field microscopy; survival curves for various doses of x-rays and nitrogen mustard are included. It was found that both 0.46 γ of nitrogen mustard and 140 r of x-rays had a

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delayed cytocidal action on rabbit thymic cells at 37°C; cells incubated at 17 and 45°C were killed by 1 γ of nitrogen mustard but not by 1,000 r of x-rays. Acid was found to increase the reactivity of nitrogen mustard but inhibited the cytocidal action of x-rays. The cells of rabbit bone marrow and human blood cells from patients with myelogenous leukemia were moderately sensitive to 1-10 γ of nitrogen mustard, but were resistant to 1,000 r of x-rays; the blood cells from patients with lymphatic leukemia were sensitive to nitrogen mustard in two cases studied and to x-rays in 6 out of the 12 cases studied. Irradiation and incubation of thymic cells induced primary and secondary vacuoles, while large doses of nitrogen mustard caused no vacuole development but did elicit coarsening of intranuclear granules and moderate edema of the cytoplasm. The similarities and differences in the reactions of x-rays and nitrogen mustard suggest to the author that the two reagents may produce different effects on the same nuclear compound.

987 Cyclotron-Induced Radiation Cataracts. P. H. Abelson and P. G. Kruger. Science 110, 655-7 (1949) Dec. 16.

This is a preliminary report of a survey, carried out under the auspices of the Division of Medical Sciences of the National Research Council, concerning cyclotron-induced radiation cataracts. A summary is given of the results of an examination carried out at the Wilmer Ophthalmological Institute, Johns Hopkins School of Medicine, by Drs. Alan Woods, Jonas Friedenberg, and Algernon Reese, on ten scientists, who in connection with their work on high energy machines had been exposed to harmful radiation. Furthermore, information is given as to the probable dates of exposure, the estimated total exposure to neutrons, and the duration of the exposure, for all ten men. It seems probable that the cataracts were caused by chronic exposure to neutrons in the energy range from 0-20 Mev.

988 Effect of Adrenal Cortical Extract and of X-radiation on Serum Proteins of Mice. John Milne and Abraham White. Proc. Soc. Exptl. Biol. Med. 72, 424-8 (1949) Nov.

The serum proteins of normal male and female mice and mice with a transplantable lymphosarcoma were investigated, both prior to and following either the injection of adrenal cortical extract, or exposure to a single dose of 200 r of total body radiation. The radiations were delivered at the rate of 43 r/min by a 125-kv machine at 30 cm skin target distance through a 3-mm Al filter; two preparations of adrenal cortical extract were used, an aqueous solution and a preparation of steroids in oil. Blood samples were taken by direct heart puncture after pithing of the animals, and upon examination of the electrophoretic serum protein patterns of these mice at 3 and 6 hr after the hormone injection and 6 hr after the exposure to x-rays it was found that there was a large increase in the serum protein levels; there was, however, no significant difference in the relative distribution of the serum proteins.

989 Effect of Protein Depletion upon Susceptibility of Rats to Total Body Irradiation. F. Lamont Jennings. Proc. Soc. Exptl. Biol. Med. 72, 487-91(1949) Nov.

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The results of the first of a series of experiments undertaken to evaluate the role of protein in radiation damage are presented. Male albino rats of the Sprague-Dawley strain were kept on a low-protein diet until they lost about 25% of their weight (10 weeks) and then were irradiated with total body x-radiation; the irradiation was delivered by a 200-kv machine through 0.5 mm Cu and 3 mm bakelite filters at a target distance of 71 cm and a dosage rate of 17-18 r/min; the depleted rats, the weight controls, and the age controls received 300-800 r doses. During the 30-day observation period following the irradiation, all the animals were maintained on the same diets as before. It was found that the protein depletion materially increase the rat susceptibility to total body irradiation and its effects; the age and weights of the controls, however, had little effect on the susceptibility to radiation.

990 The Effect of Radiation on the Biological Behavior of a Mouse Mammary Carcinoma. Henry S. Kaplan and Edwin D. Murphy. Acta Unio Intern. contra Cancrum 6, 810-11(1949).

In four separate experiments, a transplantable mouse mammary adenocarcinoma (tumor 755) was inoculated in the hind legs of groups of 40-50 mice of the C57 black strain. When the tumors reached the diameter of about 1 cm, half of the animals were treated locally with doses of 400-1,000 r with the remainder of the body carefully shielded. Animals of both the irradiated and untreated groups were sacrificed simultaneously and pulmonary metastases were found in 27 of 62 mice bearing irradiated tumors, and in five of 52 controls. Collaterally, irradiated and control tumors were removed from their hosts and inoculated subcutaneously into several alien strains of mice and into the anterior ocular chamber of guinea pigs. It was found that the irradiated tumors grew progressively in 7 of 77 alien mice and that the untreated tumors grew in 2 of 108 mice; no progressive growth was observed in guinea pigs. It is suggested that roentgen irradiation in moderate doses may alter the behavior of a tumor in the direction of increased autonomy.

991 The Effect of Radioactive Strontium on the Peripheral Blood Picture of the Normal Dog. J. Eugene Nelson, John G. Gibson, 2nd, Bert L. Vallee, and Marvin A. Van Dilla. Acta Unio Intern. contra Cancrum 6, 819-24(1949).

A mixture of Sr^{89} and Sr^{90} was given intravenously as the nitrate to two normal male dogs and one castrated dog (2 mc, 7 mc, and 20 mc, respectively). The mixture consisted of 88% of Sr^{89} (half-life 55 days; 1.5 Mev maximum β radiation) and 12% Sr^{90} (25-year half-life; 0.6-Mev maximum β radiation). Sr^{90} is followed by a daughter Y^{90} (64-hr half-life; 2.5-Mev maximum radiation); Y^{90} and Sr^{90} come into equilibrium in 4 to 5 days, accounting for 22% of total radiation thereafter. Due to the interval between experiments the ratio of radiation due to Sr^{90} and Sr^{89} was greater in the dog receiving 20 mc than in the other two. All three animals showed a decline in the white count of venous (jugular) blood which reached a maximum 21 days after injection. It was found that the fall in count in dogs 1-S (7 mc injected) and 2-S (2 mc injected) was due entirely to a reduction in the number of granuloctyes, there being no significant change

in the absolute number of lymphocytes or monocytes. The venous hematocrit fell in all three animals by more than could be accounted for by red cells removed in sampling; the fall in percent of pre-injection levels was proportional to dosage; the low points were reached at approximately the same time as the lowest white count: 21-25 days. In the dogs which survived the period of most intense leukopenia (1-S and 2-S) the hematocrit rose but not to pre-injection levels; these two animals gradually declined, lost weight, refused food and became apathetic. There was a terminal rise in rectal temperature to 41 to 42°C and death was preceded by generalized convulsions; at postmortem there were no signs of acute infection other than early bronchopneumonia of the left lobes. Sections of bone marrow from the upper portion of the femur of dog S-3 showed evidence of marked diminution of erythropoiesis and myelopoiesis. The localization and distribution of Sr^{89-90}, based on radioactivity measurements in the organs and skeleton and the approximate radiation to which the bone marrow was exposed will be discussed.

992 The Effect of Splenectomy on the Toxicity of Sr^{89} to the Hematopoeitic System of Mice. Leon O. Jacobson, Eric L. Simmons, and Matthew H. Block. J. Lab. Clin. Med. 34, 1640-55(1949) Dec.

In order to test the hypothesis that anemia fails to develop in CF-1 mice following the administration of large doses of Sr^{89} due to the rapid development of an intense ectopic erythrocytopoiesis in the spleens of the animals, the experiments described were performed. Three groups of CF-1 female mice were provided: the mice in the first group were splenectomized; those in the second group received a single intraperitoneal injection of 2.0 μc of Sr^{89}/g of body weight; and the mice in the third group were first splenectomized and 24 days later treated with the same dose of Sr^{89} as used in the second group. A second injection of 2.0 μc of Sr^{89} was given to a representative number of animals from the second and third groups. Distribution, excretion, hematologic and histologic studies were made on the animals at intervals following the injections. A persistent leucopenia but no anemia of significance was produced in the peripheral blood of the mice; the same dose of Sr^{89} produced both a leucopenia and an anemia in the splenectomized mice. Hematopoeisis was markedly reduced in the bone marrow of all irradiated mice within 3 days; recovery from the hematopoiesis and the anemia occurred usually by the 119th day. Ectopic erythrocytopoiesis and megakaryocytopoiesis were greatly increased in the spleen 3 days after the isotopic injection and lasted throughout the 119-day period of observation; splenic lymphocytopoiesis was reduced in 3 days and recovery was not complete 116 days later, while the process was essentially not affected in other tissues. Ectopic granulocytopoiesis increased more slowly in the spleen of the irradiated animals than normally. It is concluded that the rapid development and the persistence of ectopic erythrocytopoiesis in the spleen prevent anemia in the mice irradiated with 2.0 μc of Sr^{89}.

993 The Effects of X-Irradiation on Antibody Formation. L. O. Jacobson, M. E. Robson, E. K. Marks, and M. C. Goldman. J. Lab. Clin. Med. 34, 1612-13 (1949) Nov.

This communication describes an attempt to study the capacity of the rabbit to form antibodies during a period in which all lymphatic tissue of the body, with the exception of the spleen or appendix, is essentially destroyed. Young rabbits were given 800 r total body x-irradiation (exclusive of the lead-protected spleen or appendix) at 250 kv 24 hr prior to an intravenous immunization with sheep cells (1 cc of a 2% suspension). Hemolysin titers were determined on serum obtained before immunization and on samples taken 7, 14, 21, and 28 days after immunization. Normal titers were 1 to 5120 14 days after the injection; in the irradiated animals titers of 1 to 5120 were not observed until the 21st day after the injection. It is concluded that these experiments corroborate Hektoen's findings that antibody formation is suppressed by total body irradiation and also show that the capacity to produce antibodies to an injected particulate antigen is not lost when some part of the body such as the spleen or the appendix is protected from radiations which destroy lymphatic tissue.

994 The Effects of Atomic Radiation on the Oral and Pharyngeal Mucosa. Joseph L. Bernier. J. Am. Dental Assoc. 39, 647-57(1949) Dec.

This report is concerned chiefly with the changes observed in patients who received both lethal and sublethal doses of γ ionizing radiation during the atomic explosions at Hiroshima and Nagasaki. The changes in the blood and the histopathologic changes are described in detail for the three significant stages (lethal irradiation, severe but sublethal irradiation, and mild irradiation). A very early depletion of the hematopoietic system occurred with resulting anemia, agranulocytosis (shown by pharyngeal angina, gingivitis and severe secondary infections) and thrombocytopenia (manifested clinically in a few weeks by the purpuric state); epilation became evident in about 10 days. Profound and early changes of both squamous and glandular types were noted in the epithelium; lesions appeared in the oral cavity and the gastrointestinal tract. It is concluded that further studies are necessary.

995 Effects of Ionizing Radiations on Enzyme Activities of Yeast Cells. II. Influence of Dilution on X-ray Induced Inhibition of Anaerobic CO_2 Production and Colony Formation. Frederick G. Sherman and Herman B. Chase. J. Cellular Comp. Physiol. 34, 207-19(1949) Oct. (See also NSA 2-1753.)

The effects of dilution on inhibitions of anaerobic CO_2 production and colony formation in yeast were tested after the irradiation of media of various concentrations with 90,000 r (3,000 r/min/30 min) from a 200-kv source with no added filtration. It was found that diluting the cell suspension resulted in a marked augmentation of the radiation effect on the anaerobic CO_2 production in yeast grown in supplemented Reader's solution; the anaerobic production in a non-synthetic medium was not markedly inhibited at any level of cell concentration studied. Diluting the cell suspensions gave only a slight to moderate increase in the effect on colony production in Reader's solution and about the same effect in the nonsynthetic medium. Some of the implications of these and other dilution effects noted are discussed with respect to direct and indirect action of x-radiations. 28 references.

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996 The Effects of Roentgen Rays on the Infammatory Cells of the Mouse and Rabbit. William A. Townsend and Berry Campbell. Blood 4, 1346-56(1949) Dec.

An investigation was begun to determine whether morphological alterations of the inflammatory cycle could be induced by a variety of roentgen ray doses applied at times before and after inciting an inflammatory reaction in mice and rabbits. An aseptic irritant composed of egg albumin into which a small amount of india ink, as a marker, had been mixed was injected in 0.07-0.09 cc quantities into the loose subcutaneous connective tissue on the lateral part of the abdomen in mice and rabbits. In one experiment, a single injection was made into each of the mice; the mice were then given total body irradiation of 25-1600 r in groups of three or more from a 100-kv machine emitting 100 skin r in 1.3 min with no filter and at a focal distance of 30 cm. In another experiment the rabbits were locally injected with the irritant over two sites, one on either side of the abdomen; 24 hr after the injection, the rabbits were irradiated on one side only at a 15.1 cm focal distance at 100 kv through a 1.2 mm Al filter at 170 air r/min. Five other rabbits received whole body irradiation at 64.8 r/min and at a focal distance of 33 cm after four injection sites were made. Eight rabbits were given whole body deep therapy irradiation at 220 kv and 106 r/min through 0.2 mm Cu and 0.2 mm Sn filters at 33 cm focal distance. It was found that no acceleration of cell differentiation of the inflammatory cycle was induced by the treatment with x-rays of the inflammatory cells of the mouse. The intermediate polyblast was relatively the most radiosensitive of the cells, structural abnormalities being noticed following 250 r; other cells showed ranges of 700-1200 r. The inflammatory cells of the rabbit were found to be more resistant than those of the mouse. It was found that the ability of the tissue to prevent the spread of the inflammatory agent was decreased following dosages of 700 r or more. 28 references.

997 Effects of X-ray Doses on the Controlled Greying Response in Mice. Hermann B. Chase. Acta Unio Intern. contra Cancrum 6, 768-70(1949). (See also NSA 2-1323.)

The normal pigmentation process of the hair follicles in mice and the gene-controlled variations of this process were investigated through a study of the responses to x-radiations. Controlled graying response in the highly inbred C57 Black mouse strain could be obtained by plucking hairs; radiation doses were delivered by 100 and 200-kv x-ray machines, by the 20 million v betatron and by radium applications. It was found that age, sex, weight, and the specific hair location do not influence a hair response to irradiation; the stage of development of the hair does, however, affect the nature and degree of the response, maximum graying occurring when inactive or resting follicles are irradiated. The threshold for the graying effect was found to be 250 r; at 500 r, there was a 50% response, while at 1,000 r, a 95-100% response was elicited. The graying effect was found to be permanent for succeeding hair generations. It is concluded that this type of study is especially useful for comparative studies involving different species and phenotypes, different irradiation sources, natural versus induced graying, and single versus cumulative doses.

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998 Experimental Studies of the Influence of Radiation Quality, Dose Rate, and Fractionation on the Direct Injury of Cells by Ionising Radiations. L. H. Gray. Acta Unio Intern. contra Cancrum 6, 794-8(1949).

The biological effects of equal doses of different ionizing radiations (γ rays, supervoltage x-rays, soft x-rays, neutrons, and α particles were studied and correlated with the density of ionization along the tracks of ionizing particles, which varies in the extreme from six to 4,000 ions/μ; the more densely ionizing radiations were found to be either more or less effective in producing gene mutations and in bringing about enzyme inactivation in dilute aqueous solution and, in general, more effective in producing chromosome structural changes and in damaging or inhibiting the growth of many tissues including tumor tissue. Experimental data will be presented for a particular tissue (root tip meristems) belonging to this latter class. It was found experimentally, as is commonly observed in radiotherapeutic practice, that the inhibition of growth is markedly dependent on dose rate and fractionation when the radiation employed is x or γ radiation. This is not in general the case with the more densely ionizing radiations; no dose-rate dependence was observed with α radiation. It is concluded that the close interdependence of the effects of varying dose rate and quality can readily be understood by reference to the types of chromosome structural change observed to be produced in the irradiated cells.

999 Factors of Induction of Ovarian Tumors by X-rays: Types, Character and Histogenesis of These Growths. J. Furth. Acta Unio Intern. contra Cancrum 6, 785-6 (1949).

Following the irradiation of four to six weeks old mice with 87 r, 175 r, or 350 r, ovarian tumors began to appear when the mice were about 11 months of age. The frequency of these neoplasms increased with time and almost every mouse that lived 17 months developed a unilateral or bilateral ovarian growth irrespective of the dose of irradiation; these growths were transplantable and metastasizing and usually complex: granulosa, luteoma, glandular, and other types. The granulosa tumors caused estrogenization and hypervolemia, while the neoplastic lutein cell masses masculinized (caused atrophy of adrenal cortex and often obesity). It is stated that the histogenesis of these and other tumors induced by x-rays will be discussed.

1000 Influence of Cosmic Radiation on Induced Carcinogenesis in Mice. E. P. George, M. George, Joan Booth, and E. S. Horning. Nature 164, 1044-5(1949) Dec. 17 (Letter to the editor).

The results of two series of experiments on mice to determine the effect of cosmic rays on carcinogenesis are presented. Three groups of mice were injected with 0.25 mg of 20-methyl-cholanthrene in sesame oil; one group was placed in a tunnel adjoining the research station (located on the Jungfrau in Switzerland at 3,500 m altitude) under 60 m of rock, while the other two were placed on top of the station, one unscreened and the other under 2 cm of lead screening. Palpable tumors were first detected in the screened mice 10 weeks later, and five days later in the other two groups. Some complications were due to the

presence of higher ionization in the tunnel (0.14 r/week to 0.007 r/week), presumably due to natural radioactivity of the rock, and the presence of infection caused by B. pyliformis in all three groups. In a subsequent experiment, several groups of 85 mice were screened by 0, 1, 2, 5, and 10 cm of lead at sea level in London after cholanthrene injection. With the exception of the 5 cm lead screened group, the latent period between inoculation and the appearance of the tumors followed a random variation.

1001 Malignant Degeneration of Benign Giant Cell Tumor of Bone. T. Leucutia and James C. Cook. Am. J. Roentgenol. Radium Therapy 62, 685-706(1949) Nov.

Seven cases of malignant degeneration (from a series of 77 cases of benign giant tumor cells of the bone) are discussed; an eighth case is included in which fibrosarcoma of the soft tissues occurred following over-irradiation of the thymus. The malignant degenerations are said to have arisen spontaneously, following repeated surgery and irradiation, following roentgen therapy alone, or following surgery alone when bone chips were used to fill the bone cavity. Skin unit doses of 50-120% were administered to the patients in the treatment of the malignant conditions. The conclusion is drawn that the malignant degeneration of the giant cell tumor of the bone occurs in a limited number of cases as a natural sequence of evénts unaffected by the type of treatment given. 31 references.

1002 Meeting of the Botanical Teaching, General, Microbiological, Paleobotanical, Physiological, and Systematic Sections of the Botanical Society of America, Held on Sept. 10-13, 1948, at Washington. Am. J. Botany 35, 789-817(1948) Dec.

Among the papers presented at this meeting were the following: Cytological Effects of X-rays on Colchicinized Root-tips of Allium Cepa, Michael Levine; and Relationships between Radioactive Phosphorus Absorption and the Developmental Pattern of Inbred and Hybrid Maize, G. S. Rabideau, W. G. Whaley, and C. Heimsch. In the first paper it was brought out that the A. cepa root-tips were exposed 6-336 hr in a 0.01% solution colchicine, then exposed to x-irradiation of 900 r, 1500 r, or 3000 r at 18-48 hr, and daily up to 144 hr. Root-tips colchicinized for 6-24 hr showed differences in the number of scattered metaphase; after long exposure the chromosomes were fuzzy in outline and stickiness was apparent. The effect of the x-irradiation varied with the exposure to colchicine. With higher x-ray dosages impairment of cell division was marked. In the second paper the phosphorus uptakes of inbred and hybrid maize were studied with P^{32} through the root absorption method, exposures being made at weekly intervals. The highest level of radioactivity was found in the roots and the lowest in the mature leaves; the hybrid plants consistently absorbed more P^{32} than the inbred ones.

1003 Meeting of the Genetic Society of America, Held on Sept. 11-13, 1948 at Washington, D. C. Genetics 33, 603-34(1948) Nov.

Among the papers presented at this meeting were the following: Chromosome Aberrations in Tradescantia Produced by X-ray Treatment at Liquid Air Temperature, A. C. Fabergé. Genetic Differences in Radiation Effects on Resistance of Mice to Typhoid, Salmonella Typhimurium, John W. Gowen. The first of the two papers discusses the incidence and types of chromosomal breaks produced in Tradescantia seeds by x-irradiation at −192°C. It was found that the liquid air treatment by itself had no effect on the aberration incidence but nevertheless, the number of aberrations produced at the lower temperature was several times less than that produced at room temperature. In the second report the incidence and sensitivity of several irradiated mouse strains to mouse typhoid were correlated with the number of leucocytes present. It was found that exposure to x-rays reduced a strain's resistance by reducing the number of leucocytes.

1004 Neutron Effects on Alkaline Phosphatase of Rat Intestine. M. H. Ross and J. O. Ely. Am. J. Roentgenol. Radium Therapy 62, 723-5(1949) Nov.

The effect of neutron irradiation of 200 n on the alkaline phosphatase concentration of the rat duodenum was investigated in ten albino rats of the Brooklyn strain. An increase in alkaline phosphatase activity at pH 9.0 was found in the nuclei and nucleoli in the cells of the crypts of Lieberkühn when β-glycerophosphate, desoxyribonucleic acid, ribonucleic aicd, adenylic acid, guanylic acid, or diphenyl phosphate was used as the source of organic phosphorus. No difference could be observed between the phosphatase activity of the cells in the villi of the duodenum from irradiated and from nonirradiated animals. No difference in phosphatase activity at pH 7.0 was noted in any of the parts of the duodenum of irradiated and nonirradiated animals with any of these substrates.

1005 Neutron and Roentgen-Ray Effects on Protein Content of Rat Intestine. M. H. Ross and J. O. Ely. Am. J. Roentgenol. Radium Therapy 62, 718-22 (1949) Nov.

The present investigations are extensions of previous studies on the effects of penetrating radiations on the chemical constituents of the cells of the crypts of Lieberkühn. White rats of the Brooklyn strain were used for the estimation of total protein; 10 rats received 600 r of roentgen radiation, 9 received 56 n of neutron radiation, 10 received 100 n of neutron radiation, and 10 received 200 n of neutron radiation. Each irradiated rat was paired with a control rat of the same weight and all the rats were killed 24 hr after the completion of the irradiation; sections of the duodenum of each rat were fixed in alcohol-acetic acid, embedded and sectioned, and the sections were photographed with an ultraviolet microscope for tyrosine, tryptophane and arginine determinations. In a second experiment to determine the effects of irradiation on the nitrogen content of the intestinal cells, two groups of 10 white rats were irradiated with 200 n of neutron radiation and killed 24 and 48 hr after the treatment; the entire small intestine was extraced and the total dry weight of the mucosa was determined. It was found that there was a significant decrease in the mucosa weight 24 hr after irradiation and a greater decrease 48 hr after irradiation; a slight decrease in the percentage of nitrogen was also noted after irradiation. Decreases in the tyrosine and tryptophane contents of crypts

were noted after 600 r roentgen irradiation, but not after 56 n total body neutron irradiation; decreases were also noted after irradiation with 100 and 200 n neutron irradiation; the arginine contents were found to decrease 24 hr after 600 r or 200 n irradiation. 14 references.

1006 New Experiments on the Restoration Factor of Radiobiology. Paul Lamarque and Charles Gros. J. Radiol. Electrol. 30, 539-42(1949)(in French). (See also NSA 3-2085.)

In previous experiments the authors have demonstrated (Acad. Med. 1, (1944) Nov.; J. Radiol. Electrol. 26, 129(1944-45)) that the eggs of Bombyx Mori exhibit certain restorative properties after being subjected to irradiation, and the refrigeration suspends this restoration. In the present paper, reports are given of three types of experiments: (1) the eggs were irradiated in single doses and incubated immediately afterwards; (2) the radiation was of the fractionated type, consisting of equal dosages 48 hr apart (the eggs were incubated between the treatments); and, (3) the eggs were irradiated as in experiment 2 but they were placed in a refrigerator between the first and second, and between the second and third irradiations. Total doses ranged from 300 to 3,000 r for all groups of experiments. In group 1 it was seen that the threshold of efficacy lies at about 1350 r; in order to prevent 50% of the eggs from hatching, it was necessary to use 1500 r. The eggs of group 2 exhibited more restorative power than those of group 1, probably because they were able to restore themselves partially between irradiations. Results of the third group of experiments were identical with those of group 1. This illustrates that the refrigeration serves to suspend the restoration.

1007 The Possible Carcinogenic Effects of the Atomic Bomb at Hiroshima and Nagasaki. Shields Warren. Acta Unio Intern. contra Cancrum 6, 874-7(1949).

The explosion of the atomic bombs in Japan produced injury by air blast, thermal radiation, and ionizing radiation. Air blast, both its primary and secondary effects, produced much trauma, with extensive scarring and some keloid formation resulting as the injuries to the skin healed. Thermal radiation produced burns of varying severity which also healed with extensive scarring and keloid formation; no tumors have yet developed in these scars. It is stated that it is probable that some will ultimately appear, but not to a greater extent than in burn scars from other sources. It is claimed that ionizing radiation in the amount received by survivors may be expected to produce some cases of leukemia and, possibly, some ovarian tumors. As yet no significant increase in incidence of leukemia has occurred.

1008 Radiation Effects Due to Phosphorus-32 in Fertilizer Experiments. R. Scott Russell, S. N. Adams, and R. P. Martin. Nature 164, 993-5(1949) Dec. 10. (See also NSA 2-1299.)

It has been shown in water culture (Russell and Martin, Nature 163, 71(1949)) that the rate of phosphorus absorption by plants is, under certain conditions, significantly reduced when activities of P^{32} as low as 10 μc/liter are used as a tracer. Root-growth is depressed, but the development of the aerial parts of the plants is unaffected. Effects resulting from the addition of fertilizers, labeled with P^{32}, to the soil are now being investigated. A full report will be given later in the Journal of Experimental Botany, but the preliminary work indicates that radiation damage in such experiments can be much more serious than has been heretofore suspected. Experiments were carried out with winter wheat and barley and the tabulated data shows that the amount of fertilizer phosphate absorbed is significantly depressed by the presence of the tracer, although the growth of roots and shoots may not be affected. This action of the tracer may invalidate the results of many recent experiments.

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1009 Radiophosphorus, Seedling Lethality, and Chromosome Disturbances. L. Ehrenberg, A. Gustafsson, A. Levan, and U. von Wettstein. Hereditas 35, 469-89(1949).

The cytogenetical effects of radiophosphorus, P^{32}, on the cereal seed of two-rowed barley, hexaploid spring wheat (triticum vulgare), and tetraploid wheat (triticum dicoccum) were investigated. In the different experiments the concentrations of the isotope were 0.02-25.0 μc/seed, usually in 5 ml of solution for 72 hr. It was found that doses of 5 μc/seed or more were lethal to the tetraploid wheat and nearly so to the hexaploid wheat; the cytogenetical disturbances compared with those produced by x-irradiation with 25,000 r. Barley was found to be less susceptible but with a dose of 5 μc, more than half of the cell divisions analyzed contained chromosome disturbances. Even with 2.5 μc in 100 ml of solution it was found that a treatment lasting 3 days produced chromosome fragmentation, and higher dosages demonstrated an increasing amount of such disturbances as pseudochiasmata, fragments, bridges due to stickiness (in the first 3 hr) or reunions and, finally, pronounced chromosome erosions leading to full lethality. The greater susceptibility of the wheat seeds compared to the barley seeds is explained and discussed. 14 references.

1010 The Resistance of Sciara (Diptera) to the Mutagenic Effects of Irradiation. Helen V. Crouse. Biol. Bull. 97, 311-14(1949) Dec.

A review is presented on data from previous workers in which it was noted that gross and minute chromosome rearrangements could be induced by irradiation of the germ cells of the Sciara (Diptera) but visible mutations appeared at a negligible frequency. The experiments reported in this paper were originally performed in connection with cytogenetic studies on the unusual behavior of the sex chromosome of the Sciara; in one experiment, nine females of the Sciara coprophila strain were bred singly to adult males which had been irradiated with 4,000 r of x-rays, and it was found that the dominant lethal value for the number of offspring compared almost identically with that found in Drosophila irradiated at the same intensity. Several factors are offered as possible reasons for the great differences between Sciara and Drosophila in the visible mutation rates: the external appearance of this fly (bristle pattern, pigmentation, etc.) is such that only the most conspicuous visible changes are likely to be noticed; and, there is a distinct difference between the autosomal and the sex-linked mutations, suggesting that the induced mutation rate in this genus is considerably greater than the detected mutation rate.

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1011 Studies on the Influence of Penetrating Radiations on Carcinogenesis. Frank H. Figge. Acta Unio Intern. contra Cancrum 6, 782-6(1949). (See also NSA 1-244.)

In order to test the possible influence of cosmic radiation of carcinogenesis, lead plates were placed 5-8 cm above male mice injected with 0.5 g of methylcholanthrene; the frequency of showers of cosmic radiation was thereby increased. The latent period for the induction of tumors was decreased for this group as compared with controls; repitition of this experiment using a different strain of mice gave essentially similar results; the possibility of lead toxicity as a contributing factor was tested and ruled out. Mice were also placed in coal mines at various levels; one group at 300 ft, one at 600 ft, and other groups at 1,035 ft underground. It was found that while the cosmic radiation decreased as the depth in the mine shaft increased, in this mine at least, the γ radiation increased; a group of 40 mice at the 1,035 ft level were placed in a lead cage to partially eliminate the γ radiation factor. From the results of this and related experiments there was some evidence that the cosmic particles and photons of γ radiation are synergistic and additive but not equivalent as co-carcinogenic agents. The mice shielded only in wire cages at various levels in the mine required longer latent periods for the development of the cancer in the order given: 300, 600, and 1,035 ft. It is concluded that the potency of such powerful carcinogens as methylcholanthrene may be altered by slight variations in the intensity of penetrating environmental radiations.

1012 Extrapolation Chamber Determination of Beta Ray Surface Dose Rate for Uranium and Some Uranium Compounds. H. Bass, H. DiGiovanni, and H. D. LeVine. AECD-2753, nd, Decl. Dec. 6, 1949. 34p.

The purpose of the work reported herein was to measure the β-ray surface dose rate of uranium and some of its compounds. Interest was centered on the dose rate through the stratum corneum of the portion of the fingers involved in handling activities. Since this layer has a minimum thickness of about 7 mg/cm^2, α-particle radiation is inconsequential at this depth. An extrapolation chamber was used in conjunction with a vibrating reed electrometer. The β-ray surface dose rate from uranium through a filter of 7 ± 0.4 mg/cm^2 was found to be 239 mrep/hr. Corresponding determinations were made by photographic and fixed ionization chamber methods. The results indicate the possibility of applying these two methods to field use.

1013 Detection of Radioactive Atoms in the Air with Nuclear Emulsions. C. Jech. Phys. Rev. 76, 1731-2 (1949) Dec. 1 (Letter to the editor).

Previously the author has shown that atoms of a radioactive deposit remaining in the air from the decay of radon can be collected together with the dust from the air on a very small surface area of a glass plate (Nature 163, 570(1949)). If a stream of air is directed toward a nuclear plate, dust together with radioactive atoms is collected on the surface of the emulsion. By examining the resulting tracks one has a very sensitive means of measuring the radioactive contamination of the air. Some experimental results are given. On dust spots obtained by aspirating 1,600 cc of free atmospheric

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air, on the average 35 α-tracks were found, most of which were identified as α particles of RaC. Assuming 20% efficiency this would correspond to a radon concentration of 10^{-15} curie/cc, which is consistent with the value obtained by other methods.

1014 Learning to Live with Atomic Radiation—A Challenge to Engineering Profession. Arthur E. Gorman. Civil Eng. 19, 28-9(1949) Dec.

The author discusses the research work which is being carried on in the disposal of radioactive wastes and how the Atomic Energy Commission is cooperating with other agencies in solving this problem. The need for including courses in nuclear physics in engineering curricula is briefly presented.

1015 Precautions to Be Taken in the Clinical Use of Radioactive Isotopes. L. Mallet and H. le Camus. J. Radiol. Electrol. 30, 563-6(1949)(in French).

The authors hold P^{32} to be the isotope of choice for biological application, because of its long half-life and reasonable price. Apparatus for measuring the activity of phosphorus, and units and methods of measurement are given. The amount of isotope to be used in biological work is discussed from the point of view of safety. Other isotopes given brief mention are Ca^{45}, Sr^{89}, Fe^{59}, I^{131}, Na^{24}, C^{14} and Zn^{65}.

1016 Radioactive Contamination. W. B. Lewis. National Research Council of Canada Report No. DL-4, Aug. 9, 1949. 16p.

This lecture given at Chalk River Laboratories on Aug. 9, 16, and 23, 1949, discusses basic fundamentals concerning radioactive contamination.

1017 Clinical and Pathological Observations on the Effects of the Atomic Bomb. Atomic Bomb Investigating Groups, Manhattan District, nd. 32p. (NP-1202.)

Part I. Skin Burns. Nine cases are discussed demonstrating the pathology of skin burns caused by the atomic bomb explosion at Nagasaki. The nine victims were Javanese prisoners of war who were interned in "Camp No. 14" which was just outside the area of extreme atomic bomb destruction; the burns were thus caused by the explosion of a bomb well over a mile away.

Part II. Atomic Bomb Disease. Among the survivors of the atomic bombing of Nagasaki there developed a disease, often fatal, which was apparently independent of mechanical or thermal injuries. A clinical and pathological study of the disease showed it to be entirely comparable in all respects to the syndrome caused by a large generalized dose of gamma radiation. The mortality of the disease would have been much lower provided that adequate medical care had been given.

1018 Atomic Energy in Medicine. Irving Rubin. Am. Druggist 121, 81-83, 94, 96, 98(1950) Jan.

A general description and a discussion are presented concerning the structure, types, uses and effects of radioiso-

topes in medicine; the method of production of the radioisotopes is also covered briefly. Some of the isotopes mentioned are I^{131} (in the treatment of hyperthyroidism), Co^{60} (for cancer) and P^{32} (for the treatment of polycythemia vera and leukemia) for therapy, and such tracers as C^{14}, Na^{24} and K^{42}; other radioisotopes, such as Ca^{45}, Au^{198}, Fe^{55} and Fe^{59}, Hg^{203}, Sr^{90}, S^{35}, and Zn^{65} are also briefly noted. The process of destruction of tissue by ionizing radiations and the symptoms and treatment of radiation sickness are discussed.

1019 Carcinoma of the Endometrium. Langdon Parsons. Rhode Island Med. J. 32, 668-71(1949) Dec.

The incidence, predisposing factors, symptoms, diagnosis, and the results of the treatment of carcinoma of the endometrium with radiation therapy and surgery are presented. The optimum treatment is stated to be the intrauterine application of radium at the time of curettage in a dosage of 3400-4500 mg hr, followed in six weeks by a total hysterectomy with bilateral removal of the adnexae; for the poor risk patient, radium alone is used in a dosage of 6000-7000 mg hr. It was found that upon hysterectomy after radiation therapy, 46-55% of the cases contained some residual tumor. It is concluded that with increased propaganda concerning carcinoma of the endometrium and more radical surgery following the radiation therapy, increasing salvage may be anticipated.

1020 Chronic Lymphatic Leukemia; A Study of 100 Patients Treated with Radioactive Phosphorus. John H. Lawrence, B.V.A. Low-Beer, and James W. J. Carpender. J. Am. Med. Assoc. 140, 585-8(1949) June 18.

A study of 100 cases of chronic lymphatic leukemia treated with P^{32} alone or in conjunction with roentgen rays is presented; the doses were usually 1-2 mc/week for 4-8 weeks, the treatment series being repeated if necessary (but not to exceed about 50 mc for the combined series). Comfortable life appears to have been prolonged as compared with the average life span after other methods of treatment. At the time of writing, 33% of the group have lived 5 or more years after onset and 10% 8 or more years; 24 of the patients are still living. When compared with 5-year end results in other types of neoplastic disease, such as carcinoma of the breast, prostate, lung, stomach, and esophagus, these results are concluded to be relatively good and do not encourage the prevalent hopeless attitude taken by many doctors confronted with the problem of treating chronic leukemia.

1021 Clinical Applications of Radioactive Materials. John B. Trunnell. Bull. New England Med. Center 11, 75-77(1949) Apr.

The applications of radioactive iodine (I^{131}) to the treatment of metastatic functional thyroid cancer and hyperthyroidism are discussed. It is stated that only 15-20% of the patients with metastatic thyroid cancer are intially suitable for treatment with the isotope. A majority of the remaining patients are treated successfully with thyroidectomy, pituitary thyroitrophic hormone injections, or thiouracil injections to induce greater uptake by the thyroid metastases of

I^{131}; certain types of thyroid cancer such as the papillary, spindle and giant cell, Hurthle cell, and epidermoid tumors cannot be made to collect the iodine by any technique. One of the drawbacks with this type of therapy is concluded to be spotty distribution of the isotope within the target tissue, causing intense irradiation of some parts and insufficient irradiation of others. For hyperthyroidism, a minimum 125-150 μc/estimated gram of the hyperplastic gland is suggested. No long-term results are as yet available on this treatment of metastatic functional thyroid cancer, but the immediate results were found to be promising.

1022 Clinical Radiation Dosage. II. Inter-Relation of Time, Area, and Therapeutic Ratio. Lionel Cohen. Brit. J. Radiology 22, 706-13(1949) Dec. (See also NSA 2-1697.)

Published data on skin reactions and lethal dose levels for epidermoid cancer were analyzed, and mathematical factors suitable for clinical application were derived. Nomograms, based on the above factors, were constructed and enabled the presumably most effective tumor dose to be calculated for a given set of circumstances. It is concluded that the optimal fractionation scheme, the therapeutic ratio and the maximum permissible heterogeneity can be calculated and determined for a tumor of any specified dimensions. 19 references.

1023 Culture of Human Leukaemic Blood Cells in Vitro; Some Effects of X-rays. F. W. Gunz. Brit. J. Cancer 3, 330-44(1949) Sept.

This paper presents the results of two groups of experiments on the action of x-rays on human leukemic blood cells; in the first group of experiments, the leucocytes were directly irradiated in vitro; in the second, they are explanted after the therapeutic irradiation of the patient. Samples of the venous blood of eight patients with chronic myeloid leukemia were incubated in a culture for 15 min, then irradiated with either 10, 50, 100, 1,000, or 10,000 r by a 220-kv apparatus at a target distance of either 21 or 81 cm and at a dosage rate of 622 or 62 r/min, respectively. It was found that mitosis was temporarily inhibited by a dose of 100 r, and apparently permanently inhibited by 1,000 r; as a result the number of immature leucocytes declined in the cultures. No increase in mitotic abnormalities occurred except when special arrangements were made, in which case a large number of abnormal, degenerating cells appeared, probably derived from breaking-down prophases. There was no sign that the x-rays acted by direct destruction of the resting cells. In the second series of experiments the leukemic leucocytes taken and cultered after the therapeutic irradiation of the patients showed a diminished proliferative activity in vitro.

1024 Epidermoid Carcinoma of the Tongue; A Study Based on Ninety-five Cases. Thomas Perry, Jr., and Edward S. Cameron. Rhode Island Med. J. 32, 663-6(1949) Dec.

Ninety-five cases of epidermoid carcinoma of the tongue are reviewed and statistics on the age, sex, and grade of the

lesions are presented. Thirty-three of the cases received only palliative x-ray therapy because of advanced disease; of the remaining cases, 47 received radiation therapy alone and there was a 23.4% 3-year cure rate. Of the 15 cases treated primarily by surgery, with additional radiation therapy in some form, there was a 26.6% 3-year cure rate. Many of the cures were not affected until several attempts had been made. A plea is presented for more radical and earlier surgery in both the tongue and neck to improve the present poor results.

1025 Evaluation of the Deep Dosis in Cyclotherapy. J. Malvoisin. J. Radiol. Electrol. 30, 581-3(1949) (in French).

A graphical method is shown for the determination of the deep dosis in cyclotherapy from the following data: intensities of radiation before (I_o) and after (I_s) its passage through the patient's body, and the anatomical topography of the region involved. In the case of parallel rays and of two kinds of tissue, a and b, traversed, with total thicknesses d_a and d_b, the absorption coefficients x_a and x_b can be found from the equations $\log(I_o/I_s) = d_a x_a + d_b x_b$ and $\log(I'_o/I'_s) = d'_a x_a + d'_b x_b$, corresponding to two angles of rotation. Then, for a complete rotation, curves are constructed giving, for every successive second, the values of the intensity I both for the center of rotation and for any other point. By summing up these values (for n seconds during which the point was irradiated), and by multiplying the sum by the corresponding absorption coefficient, the total quantity Q of radiation absorbed by the given point is determined: $Q = x(I_1 + I_2 + \ldots + I_n)$. The method can be extended for the case of conical beams.

1026 Herpes Zoster after Irradiation. Frank Ellis and Basil A. Stoll. Brit. Med. J., 1323-8(1949) Dec. 10.

A report is presented on the development of Herpes zoster in 45 cases after treatment with x-irradiation; 39 of the cases were irradiated because of malignancies, 24 of which were carcinoma of the breast. The literature is reviewed, and discussed. On analysis of the cases it was noted that the average time interval between the last irradiation and the development of the disease was 3-6 months and that maximal incidence occurred at the somatic level of the neoplasm, the site of the irradiation; there was little evidence of malignant involvement of the posterior nerve root. It is concluded that zoster may result from either a systemic mechanism following the release of substances set free by irradiation, or from an effect at the level of the cord concerned, through the afferent nerves of the irradiated area. 20 references.

1027 The Influence of the Protein Content of the Diet on the Response of Walker Rat Carcinoma 256 to X-radiation. L. A. Elson and L. F. Lamerton. Brit. J. Cancer 3, 414-26(1949) Sept.

The effect of diets containing 20 and 5% protein, respectively, on the response of Walker rat carcinoma 256 to whole body x-radiation and to localized irradiation of the tumor was investigated. For whole body radiation (100 r daily for 8 days

commencing 24 hr after tumor implantation) or for localized irradiation of the established tumor with 4,000 r total dose applied in daily doses of 250 r, commencing 6 days after tumor implantation, inhibition of tumor growth was greatest in those animals maintained on the low protein diet, but no complete regressions of the tumor were obtained. With localized irradiation of the tumor, when the total dose of 4,000 r was applied in larger daily doses, complete regression of some tumors was observed, and the most favorable results were obtained by the application of an initial dose of 1,000 r with extended time intervals between successive smaller doses. Complete regression of the tumors was then obtained in about 90% of the animals maintained on the high protein diet, but in only about 15% of those maintained on the low protein diet. It is suggested that two effects are concerned in the response of tumors to radiation, (1) the initial inhibition of tumor growth, (2) the elimination of the inhibited tumor and cure of the animal. Process 1 is favored by a low protein diet, and process 2 by a high protein diet. 14 references.

1028 Location of Brain Tumors by Means of Radioactive Phosphorus. B. Selverstone, A. K. Solomon, and W. H. Sweet. J. Am. Med. Assoc. 140, 277-8(1949) May 21. (See also NSA 4-53.)

The results of experiments to determine whether radioactive phosphorus (P^{32}) would concentrate in cerebral tumors to a greater degree than in normal gray and white brain matter are presented. Tracer doses of P^{32} (0.95-4.2 mc), in a buffered phosphate solution, were given intravenously to patients with various types of cerebral tumor 1.8 to 65.8 hr prior to the operation, and at operation aliquots of the tumor tissue were removed at intervals and compared with the radioactivity of normal white and gray matter samples taken at the same time. It was found that the radioactivity of the tumor tissue was 5.8-110 times greater than the adjacent normal white matter, and although the activity of the gray matter was higher than that of the white, it never approached that of the tumorous tissue. The precise location of the tumor could be determined within a maximum distance of 7.5 mm in the tissue in the group of 14 cases considered, in which glioblastoma, astroblastoma, astrocytoma, and atypical glioma tumors were tested.

1029 The Radioisotopes in Medicine. George M. Lyon. J. Am. Osteopath. Assoc. 49, 103-8(1949) Oct.

A similar article by the author appeared in Military Surgeon 104, 171-175(1949) Mar. An abstract of this article was published in Nuclear Science Abstracts as Abstract No. 2-1728.

1030 A Report on the Use of the Radium D Applicator. Robert W. Harger and A. D. Ruedemann. Kresge Eye Inst. Bull. 1, 19-37(1949) Nov.

The results of the treatment of about 250 lesions of the cornea with β irradiation from a 20-25 mc Radium D applicator are presented. More than 80% of the cases were corneal scars, most of which showed some form of improvement upon irradiation; the total dosages were 4-79 mc delivered over 1-23 months. The most important result of this

type of therapy is concluded to be comfort to the patient; photophobia and lacrimation are arrested and pain is relieved. Vision in a majority of cases is improved and the appearance of the lesion and, consequently, the whole eye is measurably improved. The authors conclude that this therapy is the most advantageous yet devised for these lesions.

1031 Roentgentherapy of Benign Giant-Cell Tumor of Bone. Franz Buschke and Simeon T. Cantril. Cancer 2, 293-315(1949) Mar.

A total of 10 cases of giant-cell tumor of the bone treated by x-radiations are presented. Most of the cases showed radiations delivered by a 200-kv source and total dosages of 3,000-7,730 r over periods of 17-98 days. Nine of the cases showed adequate success after periods of 1-10 years; one of the cases suffered a recurrence of the disease, and amputation of the hand was performed. The results of the study of the cases indicate to the authors that the method of treatment for tumors that can be widely excised without mutilation is surgery, while roentgen therapy is indicated for tumors in inaccessible places; doubtful cases are to be treated with wide excision if feasible. 22 references.

1032 The Roentgentherapy of Hodgkin's Disease. M. Giraud. J. Radiol. Electrol. 30, 574-8(1949) (in French).

Two techniques were used in the treatment of Hodgkin's disease: teleroentgentherapy and roentgen therapy of single fields; the latter was used more frequently, and consisted of delivery of radiations from a 180-200-kv source at a filtration of 1 mm Cu and at dosages of 200 r per session; each area irradiated received a total of 1200-2000 r. Of the 132 cases discussed, 10 terminated after one series of radiation therapy and before the end of the first year; it was found that the therapy often produced a remission for several years, but infrequently for as long as five years. The optimal type of therapy was the irradiation of all the regions damaged or suspected of being damaged in the first series with a view toward clearing or cleansing these areas as far as possible; subsequent series were irradiated until radioresistance or other signs of contraindication were met. Systematic radioscopic examinations of the thorax and examinations of the abdominal regions were coordinated with blood tests in order to detect any recurrences. It is concluded that it is important to use a powerful but rational therapeutic technique to obtain the maximal results.

1033 Symposium on Small Field X-ray Therapy for Deep-Seated Tumours, with Special Reference to Rotation Techniques. P. R. Steed, A. D. O'Connor, L. F. Lamerton, J. G. Winternitz, W. V. Mayneord, and D. W. Smithers. Brit. J. Radiology 22, 185-209 (1949) Apr.

This symposium is concerned with some developments in the application of multiple small field x-ray therapy for deep-seated tumors, with special reference to rotation techniques. The general principles of beam direction are discussed, the particular method of beam direction used in rotation therapy described, and a method of "discontinuous rotation" set out in full. The method of assessing the three-dimensional dose distribution of the rotation is described and some examples are are presented. A method of checking the accuracy of the application of the radiation to the patient during treatment is also given.

1034 The Synchrotron Accelerator—Its Potentialties as a Generator of X-rays and Electrons of 10-50-Mev Energies for Medical Use. D. W. Fry. Brit. J. Radiology 22, 462-72(1949) Aug.

The principle of the electron synchrotron is given, showing its relationship to the betatron and the cyclotron. This is followed by a description of the main characteristics of a β synchrotron, and the sequence of operations during the accelerating cycle, illustrated by reference to the operating characteristics of a 14-Mev and a 30-Mev electron synchrotron. For the latter machine an output of 13 r/min at 1 m has been obtained. The x-radiation characteristics are outlined, i.e., (1) angular intensity distribution, (2) energy spectrum, (3) mean intensity, and (4) output pulse shape; reference being made to the characteristics of betatrons of similar energies. The possibility is discussed of extracting for clinical use the electron beam from a synchrotron. The main factors controlling the engineering design of an electron synchrotron, i.e., size, weight, noise, power consumption, etc., are also discussed briefly. It is pointed out that the main factor controlling the design of both betatrons and synchrotrons is the injection process. If an improvement in the efficiency of this (at present never greater than 10%) could be made, a major improvement would follow in synchrotrons and betatrons designed for clinical work.

1035 The Treatment of Recurrent Otitic Barotrauma by Irradiation (with Special Reference to Lymphoid Tissue in the Sub-Mucosa of the Eustachian Tube). E. D. D. Dickson and J. E. G. McGibbon. J. Laryng. and Otology 63, 647-71(1949)Nov.

The work described here was undertaken to determine a suitable method of treatment by irradiation of a series of patients suffering from recurrent otitic barotrauma. The unilateral and bilateral x-irradiation of the eustachian tube in order to eliminate lymphoid tissue was begun on a series of 42 patients; doses were delivered at 200 kv through a filtration of 2 mm Cu and 1 mm Al and at a distance of 50 cm. Daily doses of 100 r were given until a total dose of 860-1,245 r was administered; a total of 36.5% of the cases treated were considered successes. The total dosage was increased to 1,250-1,520 r for a subsequent series of patients, and the successes increased to 56.5%. A description is presented concerning a head apparatus to facilitate alignment and accurate irradiation of the necessary head regions. Skin reactions as evidenced by erythema, were noticed in a proportion of the cases treated; mucosal reactions occurred in a negligible number of cases and were only temporary; headaches occurred occasionally, but were not serious. The authors conclude that the disadvantage of the therapy is that a considerable amount of tissue must be irradiated, which is time-consuming. The series treated, however, by this method showed encouraging results. 11 references.

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1036 The Use of Cobalt 60 in Curietherapy. Robert Coliez. J. Radiol. Electrol. 30, 518-24(1949) (in French).

A general discussion of the use of Co^{60} in curietherapy is presented; the isotope is compared with radium from the standpoint of effectiveness, economy, and availability. It is pointed out that the smaller apparatus necessary when Co^{60} is used permits the production of more complex and highly integrated apparatus for the treatment of specific types of cancer.

1037 Value of Roentgentherapy in the Treatment of Whooping Cough. J. Prouzet et Escande. J. Radiol. Electrol. 30, 526-7(1949) (in French).

A total of 138 persons with whooping cough were treated by thoracic roentgen therapy, and of these, 96% evidenced encouraging results. The therapy consisted of x-ray doses of 50-100 r delivered by a 100-140-kv machine through a filtration of 5 mm Al or 1 mm Cu to the thoracic region; the therapy was given every three days and it was noted that in most of the patients disappearance of the night cough occurred after the second treatment and suppression of the daytime cough occurred after the fourth or fifth treatment. It is concluded that the appearance of the coughs constitutes the most favorable time for beginning the irradiations.

CHEMISTRY

1038 Fitting of the Lanthanides and Actinides into the Periodic System. Fritz Scheele. Z. Naturforsch. 4a, 137-9(1949) May (in German).

Starting with the characterization of the elements with atomic number 89 and higher, as a second series of rare earths (actinides) the valences of Th and U are discussed in connection with the filling up of the 5 f-shell. A comparison is made with the valences of the lanthanides. Finally, a systematic way of fitting both series into the periodic system is proposed.

1039 The New Chemical Elements and the Periodic System. M. Haissinsky. Bull. soc. chim. France 16, 668-78(1949) Sept.-Oct. (in French).

This article outlines the chemical properties of the elements 43, 61, 85, and 87, as well as those of the more recently discovered transuranic elements. It is noted that the elements 43, 61, and 85 fit into the periodic table very well, while the properties of the other elements could not have been predicted. Facts about the various elements are summarized in tables which give the atomic weights, life times, and the modes of formation and disintegration of their isotopes. Valences and other chemical properties are described in detail.

1040 Chemistry of Thorium in Aqueous Solutions. I. Some Organic and Inorganic Complexes. R. A. Day, Jr., and R. W. Stoughton. AECD-2756, Oct. 25, 1949, Decl. Dec. 9, 1949. 22p. Proposed for publication in J. Phys. and Colloid Chem.

The stability constants of the complex ions of thorium with anions of the acids HCl, HNO_3, $HClO_3$, $HBrO_3$, HF, $ClCH_2COOH$, $Cl_2CHCOOH$ and Cl_3CCOOH have been evaluated at a hydrogen ion concentration and ionic strength of 0.5 by use of the TTA (thenoyltrifluoroacetone)-benzene solvent extraction method. Evidence is cited for the existence of double complexes of the type $Th(NO_3)F^{+2}$ and $Th(NO_3)F_2^{+}$ in mixtures of nitric and hydrofluoric acids. No evidence was found for the existence of similar species involving nitrate and iodate ions. It was found that the presence of acetic acid in the aqueous phase increases the extractability of the chelated product formed between thorium and TTA. Some other organic acids also showed a tendency in this direction. 18 references. (auth)

1041 The Stability of Gaseous Nickel Oxide. Leo Brewer and Donald F. Mastick. UCRL-532, Nov. 1949. 15p.

A thermodynamic treatment of Johnston and Marshall's data (J. Am. Chem. Soc. 62, 1383(1940)) for the vapor pressure of NiO indicates that the dissociation mechanism accounts for weight losses observed when NiO is heated at high temperatures in vacuum. It is shown that their data actually affords a calculated heat of dissociation which is almost exactly the heat which they chose in their calculations of the dissociation. The probable reasons that they concluded that dissociation was completely negligible are: (1) the same data will give calculated oxygen pressures which are one-third of the calculated NiO pressures because of the difference in molecular weights, and (2) the oxygen pressures upon which they drew their conclusion were calculated from existing thermodynamic data in the use of which an error was made which resulted a lowering of their results by a factor of 2. Also, it is shown that the treatment of their data assuming dissociation yields a heat of dissociation which is higher than any heat in the literature; and thus if the oxygen pressure were reduced by combination with nickel to form the NiO(g) species, the calculated heat of dissociation only could diverge more from the literature values. It is shown experimentally that NiO changes in composition during heating at about 1800°K in an effusion cell such that upon cooling both a NiO and metallic nickel phase are present. The same phases are found in the effusate which is collected on a water-cooled platinum collector. Since Johnston and Marshall's data (ibid) show that from such a system containing both nickel and NiO phase the initial ratio of oxygen to nickel atoms escaping must be about 0.1, it is concluded that the nickel phase must gradually disappear leaving a NiO phase which will lose nickel until the composition of the solid is equal to the composition of the vapor, after which no further change in composition will occur. Since both the NiO and metallic nickel phases appear upon cooling, it appears that the single oxide phase which is formed at the high temperature must disproportionate upon cooling; that is, the NiO must have a wide solid solution range with an increasing solubility of nickel in the oxide phase with increasing temperature. Upon heating NiO to 1629°K for 4 min, gradually cooling to 1296°K, and holding at the latter temperature for 1 hr, it is found upon cooling that the x-ray diffraction pattern is sharp and unchanged from that of the unheated NiO and that no metallic nickel lines are present. Therefore, the original NiO is not metastable with respect to disproportionation and furthermore does not contain a reducing impurity which can account for the appearance of the nickel phase in the effusion experiments. If only the species NiO(g) were vaporizing from the effusion chamber, the neces-

sary change in composition for the disproportionation could not occur and thus dissociation is indicated as an important process in the vaporization. In conclusion, it is found that Johnston and Marshall's data (ibid) actually afford a better fit to the vaporization of NiO by dissociation than to vaporization to the species NiO(g) as proposed by them. Experimental studies of the vaporization of NiO from an effusion chamber further support the dissociation mechanism. 11 references. (auth)

1042 The Halides of Columbium (Niobium) and Tantalum. Part II. The Vapour Pressure of Tantalum Pentaiodide. Kenneth M. Alexander and Fred Fairbrother. J. Chem. Soc., 2472-6(1949) Oct.

Tantalum pentaiodide has been prepared by heating the metal in iodine vapor by means of high-frequency induction currents. It forms shiny black crystals which can be sublimed without decomposition; mp 496°; bp 543°. Measurements have been made, by a static method using a Bourdon-type sickle gauge, of its vapor pressure over a range of temperatures. It is not reduced by metallic tantalum at 550° but is thermally decomposed on the surface of incandescent tantalum. The iodide of columbium, prepared by the action of heated columbium on iodine vapor, forms brass-like crystals which are instantly attacked on exposure to the air and which lose iodine on gentle heating.

1043 Nitrogen Purification Process. A. S. Newton (to U. S. Atomic Energy Commission). U. S. Patent 2,487,360, Nov. 8, 1949.

A simplified method for the purification of nitrogen by the removal of oxygen is described. The nitrogen gas is purified from oxygen and certain other gaseous impurities by passing it over uranium nitride (of formula $UN_{1.5}$ to $UN_{1.75}$) while maintaining the nitride at an elevated temperature usually not less than 200°C and preferably about 500-600°C; the process may be used singly or in conjunction with other purification processes. The uranium nitride suitable for use may be prepared by passing ammonia gas or nitrogen over uranium turnings at about 800°C; other reactive nitrides may also be used.

1044 Some Physico-Chemical Studies on Gallium and Thallium Compounds. Therald Moeller and Glenda'l Lee King. University of Illinois Technical Report (N6ori-71-Chemistry Task No. XVII), Nov. 15, 1949. 57p. (NP-1233)

The acidic characteristics of gallium(III) and thallium(III) ions in aqueous solutions have been studied by electrometric titrations with sodium hydroxide and by hydrogen ion determinations as functions of concentration.

In the presence of sulfate ion, electrometric titration has shown hydrous gallium(III) oxide to begin precipitating when the mole ratio of added hydroxyl ion to gallium ion approximates 1 and to be complete when this ratio reaches 3. At 25°C. the average pH for precipitation is 2.77. In the presence of bromide, chloride, or nitrate ion, apparent precipitation is delayed until the OH^-/Ga^{+3} ratio reaches 3, where complete flocculation occurs. The pH values characterizing

these changes are not too consistent. In all cases, dissolution of the hydrous gallium(III) oxide precipitates in excess hydroxyl ion occurs only after addition of 5-6 moles of hydroxyl ion. Solubility product constants for hydrous gallium (III) hydroxide of the order of 10^{-35} and corresponding water solubilities of the order of 10^{-10}M have been evaluated from data on sulfate solutions. Hydrolysis in dilute gallium(III) bromide, chloride, and nitrate solutions has been shown to be governed by formation of $GaOH^{+2}$ ions and to correspond to hydrolysis of 4.6×10^{-4}, 4.1×10^{-4}, and 3.7×10^{-4}, respectively, over the concentration range 0.004 to 0.25 M at 25°C. Polarographic investigations have indicated that hydroxyl-gallium ions of increasing complexity are formed in solutions of gallium(III) ion to which an insufficient quantity of hydroxyl ion has been added to cause precipitation of the hydrous oxide. High temperature sintering reactions have indicated that gallium(III) oxide is sufficiently acidic to enter into combination with the oxides of barium, cadmium, copper, lanthanum, magnesium, strontium, and zinc to form, in general, spinel-like compounds.

In sulfuric acid solution, electrometric titration has shown hydrous thallium(III) oxide to begin precipitation at an average pH of 0.99. In the presence of bromide and chloride ion, precipitation of hydrous thallium(III) oxide takes place at an average pH of 3.63 and 3.29 and at a mole ratio of hydroxyl to thallium(III) ion of 0.25 and 0.67 for bromide and chloride solutions, respectively. Solubility product constants of the order of 10^{-27}, 10^{-33}, and 10^{-37}, and corresponding water solubilities of the order of 10^{-7}, 10^{-8}, and 10^{-10} have been evaluated from thallium(III) bromide, chloride, and sulfate data, respectively. Hydrolysis in dilute thallium(III) bromide and chloride solution has been shown to be governed by formation of $TlOH^{+2}$ ions and to correspond to hydrolysis constants of 4.2×10^{-3} and 3.3×10^{-3}, respectively, at 25°C. 53 references. (auth)

1045 Automatic Precision Glass-Electrode-pH Measurement with a Vibrating Reed Electrometer. Kurt A. Kraus, Robert W. Holmberg, and C. J. Borkowski. ORNL-383, Sept. 20, 1949. 19p.

The use of the vibrating reed electrometer (also called dynamic condenser or capacitative commutator) for high precision pH measurements with glass-electrodes is described. The electrometer is used as a detector, and the potentials of glass-electrode assemblies are recorded on a strip chart recorder. The precision of the measurements is approximately that of a type K potentiometer and the reproducibility is sufficiently high to make it feasible to determine acidities of solutions to better than 0.1% under favorable conditions.

1046 Crucible and Method of Making Crucibles. Robert J. Anicetti (to United States Atomic Energy Commission). U. S. Patent 2,472,456, June 7, 1949.

The invention relates to improvements in crucibles and methods of making crucibles in which the bottom members may be replaced. The side walls and bottom members are separately constructed, and machined so that the bottom member may be held in place without the use of flanges.

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The bottom member consists of a disc, flat on one side, but machined on the other so that the surface slopes toward a discharge outlet. Side walls may be made by molding and firing graphite or other material, or by drilling or coring cylinders of graphite which may then be fired.

1047 Direct-Reading Spectrometer. Earl R. Vance. J. Metals 1, 28-30(1949) Oct.

A rapid control analysis is possible for certain elements with the direct-reading spectrometer. In this instrument, the photographic stage has been replaced by sensitive photo multiplier tubes, which pick up the emitted light from the elements, at the various wavelengths. Within 35 sec after the sample has been placed in the electrode holders, calibrated clock dials indicate the analysis in per cent. The direct reader is used on all types of steels with the exception of the stainless grades for elements in the following ranges:

Element	Calibration range	Element	Calibration range
Manganese	0.05-1.60	Copper	0.02-1.20
Silicon	0.01-1.00	Vanadium	0.01-0.30
Chrome	0.03-7.00	Tungsten	0.05-5.40
Nickel	0.02-5.00	Aluminum	0.002-1.60
Molybdenum	0.01-1.00	Tin	0.007-0.10

The spectrometer is kept in an air conditioned room at a temperature of 75°F and 50% relative humidity. Twenty determinations were made on both the spectrometer and spectrograph using identical pins from 4320 type steel to see if any gain in accuracy resulted from using the former. The table listed below shows the difference in accuracy of the two methods.

Elements	Chemical analysis	Spectro-graph	Spectrome-ter	Extremes, Spectrometer
Manganese	0.55	1.82	1.35	0.54-0.56
Silicon	0.28	1.97	2.46	0.27-0.29
Chrome	0.45	1.92	2.06	0.44-0.47
Nickel	1.69	1.85	0.79	1.68-1.71
Molybde-num	0.215	2.66	1.68	0.21-0.22

1048 Glass Magnetic Stopcock. Clifford E. Herrick, Jr., and Laurence C. Liberatore (to United States Atomic Energy Commission). U. S. Patent 2,442,599, June 1, 1948.

When using corrosive gases it is sometimes necessary to use stopcocks without lubricants. However, if the stopcock sticks, it must be unseated and air will be admitted to the system. In order to avoid this difficulty a stopcock has been devised which is entirely enclosed by the tube carrying the gas. The section of the tube containing this stopcock is vertical and is surrounded by a coil which may be activated by a key. When the key is open, the stopcock is seated, but closing the key raises a piece of iron attached to the stopcock and unseats it. If the stopcock is stuck, it may be jarred loose by repeatedly opening and closing the key. The stopcock thus acts as a magnetically controlled valve.

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1049 Molecular Still for Small Volumes. John N. Roper, Jr. Anal. Chem. 21, 1575(1949) Dec.

A semimicro molecular still, similar in principle to the one described by Breger (Anal. Chem. 20, 980(1948)) is described.

1050 Photoelectric Colorimeter for Use in Microanalysis. Gordon H. Ellis and C. Stafford Brandt. Anal. Chem. 21, 1546-8(1949) Dec.

A photoelectric colorimeter is described which may be used with a variety of cuvettes, including those with an absorption path of 10 cm and a capacity of 0.4 ml. Two amplifier circuits—one battery-operated, the other line-operated—are described. In either case, per cent transmittance is read directly from a meter. The application of the colorimeter in determining concentrations of biological traces such as Co and Cu in the tissues of laboratory animals is discussed. Diagrams and illustrations.

1051 Report on Recommended Specifications for Microchemical Apparatus; Carbon-Hydrogen, Dumas Nitrogen, Sulfur, and Halogen. Committee for the Standardization of Microchemical Apparatus, Division of Analytical Chemistry, American Chemical Society, Al Steyermark, Chairman. Anal. Chem. 21, 1555-65 (1949) Dec.

A report is given by the Committee for the Standardization of Microchemical Apparatus, appointed in 1947, of recommended specifications for microchemical apparatus to be used in connection with the carbon-hydrogen, Dumas nitrogen, halogen, and sulfur determinations. The report includes both unchanged and revised recommended specifications, so that all are together for easy reference. Changes are presented for many items to increase efficiency, add strength, and simplify the manufacture. 36 figures.

1052 Safety Pipette. Edward L. Brady and Lawrence E. Glendenin (to Director of the Office of Scientific Research and Development, Office for Emergency Management). U. S. Patent 2,423,173, July 1, 1947.

In using a pipet it sometimes happens that liquid is drawn into the user's mouth. In order to avoid this possibility a small disc of sintered glass is sealed into the pipet. Such disc permits the passage of air when dry but is impervious when wet. The liquid will, therefore, not pass the disc.

1053 Torsion Balance. Roderick Craig and Robert Q. Boyer (to Director of the Office of Scientific Research and Development, Office of Emergency Management). U. S. Patent 2,417,392, Mar. 11, 1947.

An improved optical system is described for viewing the beam of a torsion balance so that the condition of balance may be accurately ascertained. The optical system consists of lucite rods by means of which parallel light beams are transmitted from light sources into the region traversed by the indicator strand during operation of the balance, and of a system of lenses and prisms by means of which an image of the illuminated portion of the strand will be transmitted to

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a screen. Advantages claimed for the invention are the following: the state of balance can be determined regardless of lateral displacements of the sag of the torsion member, and regardless of the lateral displacement of the weighing beam. Portions of the weighing beam may be viewed at a common point so that their relative position will become readily apparent.

1054 Determination of Small Amounts of Zirconium with Mandelic Acid. Richard B. Hahn. Anal. Chem. 21, 1579-80(1949) Dec.

Data show that the mandelic acid method is as accurate as the phosphate method in determining small amounts of zirconium. A complete determination of zirconium may be made within an hour, using mandelic acid, whereas a much longer period is needed for the phosphate method.

1055 A Geiger-Mueller Counter Method of Determining Phosphorus in Steels. Ford R. Bryan and George A. Nahstoll. Bull. Am. Soc. Test. Mater. No. 157, 55-61(1949) Mar.

The authors discuss the equipment used and the procedure necessary for the determination of phosphorus in steels. Several curves are included. The principal ones are as follows: effect of electrode diameter on ratio of phosphorus counts to iron counts; effect of arc current on ratio of phosphorus counts to iron counts; effect of temperature on phosphorus line position; working curve for analysis of low phosphorus steels; working curves for alloys differing primarily in carbon content. A comparison of the results obtained with the Geiger counter and routine chemical analysis is given in tabular form.

1056 Industrial Chromatography. I. Column Chromatography and Radial Chromatography. Herbert Weil. Can. Chem. Process Inds. 33, 956-9(1949) Nov.

New developments in radial and column chromatography are given and the advantages of radial chromatography are listed. New mechanical isolation equipment and a new separator are described. 14 references.

1057 Modern Instrumental Analysis. Vol. I. David F. Boltz, Ed. Ann Arbor, Edwards Bros., Inc., 1949. 191p.

In this first of two volumes on the subject of instrumental analysis edited by Professor Boltz of Wayne University, six well qualified authors have written chapters on spectrochemical analysis (two chapters), mass spectrometry, optical instruments, electron diffraction, and x-ray diffraction. This small paper-bound volume is lithoprinted and the illustrations, especially the line drawings, are good.

1058 Oxygen in Titanium. Gerhard Derge. J. Metals 1, 31-33(1949) Oct.

The author describes a reliable method of oxygen analysis by a modification of the vacuum fusion techniques which have become conventional for the analysis of gases in steel.

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Titanium-oxygen alloys containing up to 0.5% oxygen have been analyzed satisfactorily using this method.

1059 Self-Absorption Curves of C^{14}-Labeled Barium Carbonate, Glucose, and Fatty Acids; Influence of Physical Form of Sample. Arne N. Wick, Harry N. Barnet, and Nancy Ackerman. Anal. Chem. 21, 1511-13(1949) Dec.

Comparative self-absorption curves of C^{14}-labeled barium carbonate, glucose, and fatty acids are given. It is shown that these curves are dependent on the technique employed in the sample preparation. In counting solid samples the physical form and density should be comparable in order to obtain reproducible results.

1060 Use of Glycolic Acid Derivatives in Determination of Zirconium. Ralph E. Oesper and Joseph J. Klingenberg. Anal. Chem. 21, 1509-11(1949) Dec.

The zirconium-precipitating action of mandelic acid is also shown by other glycolic acid derivatives. By use of appropriate derivatives, larger volumes of precipitate per unit weight of zirconium can be obtained than with mandelic acid. p-Chloromandelic acid and p-bromomandelic acid were successfully applied to the determination of zirconium in commercial zirconyl chloride, and iron-zirconium-aluminum alloy, and a silicate ore. Sulfuric acid up to 5% by weight does not prevent quantitative precipitation. The possibility of determining zirconium by direct weighing of the mandelate precipitates was investigated. The preferable reagent for the determination of zirconium by the mandelate method was found to be p-bromomandelic acid, then p-chloromandelic acid, and finally mandelic acid.

1061 Adsorption of Radium on Lead Sulfate in the Presence of Substances which Lower the Surface Tension. V. G. Khlopin and M. S. Merkulova. Izvest. Akad. Nauk S.S.S.R. Otd. Khim. Nauk, No. 5, 461(1949)(in Russian).

It is shown that the kinetic ion exchange between a solution and the surface of a crystalline phase is always hampered by substances that lower the surface tension. This is seen in the slowing down of the process, the time required for the establishment of the equilibrium being longer in all cases when substances lowering the surface tension are present, than it is in their absence. If such a substance forms a difficulty-soluble compound with the crystal ions, its presence not only slows down, but can actually suppress the kinetic ion exchange reaction; this is true in cases involving the exchange of ions of the adsorber, as well as in those of adsorption of isomorphic ions, or of co-crystallization of isomorphic substances. Effects of this kind are produced by salts of humic acids; therefore, the current method of quantitative determination of radium by co-precipitation with barium sulfate in a water solution rich in humic substances, can lead to serious errors if no special precautions are taken. In an experimental study on the adsorption of radium on lead sulphate, it is shown that correct results are obtained if both the absorbing suspension and the saturated solution are prepared in the presence of the substances which should be present in the subsequent process of primary ion adsorption.

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1062 Precipitation of Thorium from Homogeneous Solution: Separation from Rare Earths of Monazite Sand with Tetrachlorophthalic Acid. Louis Gordon, C. H. Vanselow, and Hobart H. Willard. Anal. Chem. 21, 1323-5(1949) Nov.

The reaction between thorium salts and certain dicarboxylic acids such as succinic, phthalic, and tetrachlorophthalic, proceeds extremely slowly in aqueous solution at room temperature. A visible precipitate does not form for many hours, whereas a gelatinous precipitate is obtained if the solutions are at or near boiling. When a clear solution of thorium and a dicarboxylic acid are warmed to 70° to 85°C, with continuous stirring, a thorium salt slowly precipitates in a dense, crystalline, and readily filterable form. Tetrachlorophthalic acid is the only one studied which quantitatively precipitates thorium. Upon double precipitation at pH 1.0 to 1.2, this acid effects quantitative separation of thorium from the large amounts of rare earths normally found in monazite sand. This precipitation is accomplished by a relatively simple procedure. The precipitate is ignited to the oxide.

1063 Separation of Thorium and of Its Isotopes from Radioactive Impurities. Alexis C. Pappas. Bull. soc. chim. France 16, 705-6(1949)(in French).

A method is described for the purification of Th or of its isotopes (RdTh, Io, and others) from their radioactive descendants (isotopes of Ra, Ac, Pb, and others); it is based on the procedure, worked out by Haïssinsky (Compt. rend. 155, 1788(1933)), for the separation of Ra, Ac and Th by utilizing the differences in the solubilities of their nitrates in absolute alcohol. A mixture of thorium nitrate and $Ba(NO_3)_2$ is treated with alcohol and filtered: the nitrates of the Ra isotopes are on the filter with the Ba salt, while Th and $MsTh_2$ are in the filtrate. The latter, in the presence of powdered $Ba(NO_3)_2$, is allowed to stay for three days (for the destruction of MsTh), after which a filtration separates ThX from the filtrate containing Th and ThB + ThC. The latter two are precipitated with $Pb(NO_3)_2 + H_2S$, and the new filtrate is treated with NH_3 for the precipitation of thorium hydroxide; this is calcined into ThO_2. This method leads to better results than those usually employed; thus, the activity of the ThO_2 obtained is only 0.6% of that of the equal mass of non-purified ThO_2.

1064 The Polymerization of Vinyl Chloride under the Action of α Rays. W. Mund, J. A. Herman, and G. Verfaillie. Bull. classe sci. Acad. roy. Belg. 35, 656-68(1949)(in French).

Vinyl chloride was mixed with radon and the polymers formed condensed out as a waxy precipitate. Pressure readings were taken at 3-hr intervals roughly, and the readings were tabulated for various temperature conditions and various sizes for the container. It was found that the pressure variation obeyed a single empirical law which appeared to give very accurate results.

1065 Study of the Specific Coefficients of Ionization. M. Fabre de la Ripelle. J. phys. radium 10, 319-29(1949) Nov. (in French).

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This article is a study of the ionization of atoms by electrons of a given energy. In calculating the effects of the bound electrons on the primary particle, the action of the binding force is neglected, but the atom is not assumed to be ionized unless the energy lost by the primary particle in the collision is greater than the ionization energy. Rutherford's scattering formula is used, and exchange effects are neglected. Under these conditions, the number of ionization electrons liberated per unit path length is calculated. This method was applied to the ionization of the rare gases, of hydrogen and sodium vapor. The extraction of the K-electrons of silver by an incident electron was also studied.

1066 Microwave Spectroscopy. Donald K. Coles. Westinghouse Research Laboratories Scientific Paper No. 1407, nd. 105p. (NP-1201)

An incomplete copy of a survey article on microwave spectroscopy, to be published in volume II of "Advances in Electronics" by the Academic Press, has been submitted. Chapters, following an introduction, on the beginning of microwave spectroscopy, applications of microwave spectroscopy, the width and intensity of absorption lines, and apparatus are included. 92 references.

1067 The Spectrum of Trebly Ionized Thorium, Th IV. P. F. A. Klinkenberg and R. J. Lang. Physica 15, 774-88(1949) Sept.

Investigations on the spectrum of the thorium spark in the infrared region result in the discovery of the 5^3F-6^3D-transitions and it is proved by the Zeeman-effect that 5^3F is the ground term of the spectrum; the doublet separation is 4325,38 cm^{-1}. The whole visible and ultraviolet regions are examined with a view to the pole-effect in order to isolate the Th IV-lines. Subsequently the pole-effect is studied in the vacuum region down to 1,540 A; below this limit down to 340 A the spectrum of the vacuum spark is measured. The existing analysis of Th IV is revised in the light of the newly obtained data. The chief outlines of the term scheme are confirmed, a few corrections introduced and a diagram of the correct terms is given. The ionization potential is 28.6 V approximately. Stress is laid on the necessity of carrying out observations below 1,100 A with a light source of considerably lower excitation than the customary vacuum spark.

1068 Incorporation of Isotopic Carbon into Compounds by Biosynthesis. R. H. Burris, P. W. Wilson, and R. E. Stutz. Botan. Gaz. 111, 63-9(1949) Sept.

Several closed container systems for the production of C^{14}- or C^{13}-labeled compounds by biosynthesis are described. The apparatus used for most work consisted of modification of a system incorporating a 9-liter Pyrex serum bottle, sealed and sterilized, with a fixed volume of nutrient-soaked sand in the bottom; bacteria-free red clover seedlings or other plants were germinated on sterile Petri dishes, transferred aseptically to the serum bottle and implanted. The CO_2 introduced into the sterile system was labeled with the desired isotope and the plants were grown in this environment for as long as was necessary, usually a comparatively short period of time. 11 references.

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1069 Method of Producing Calcium Hydrides by Distillation. Dick Duffey (to U. S. Atomic Energy Commission). U. S. Patent 2,452,913, Nov. 2, 1948.

It is desirable, in certain cases, to obtain calcium hydride of a purer quality than that presented by the product which is prepared from distilled Ca and H, both distillation and hydrogenation taking place in one closed system, in the absence of air. A second distillation, which would help, is not feasible, because the pyrophoric impurities (Na, K) of the once-distilled Ca would produce ignition and loss of the whole charge, if the latter is exposed to the air preparatory to redistillation. In the improvement proposed by the present patent, the inflamability of impure Ca is rendered ineffective (1) by producing an absorption of Na and K vapors by TiO_2 (a tray with TiO_2 is placed in the cooler part of the retort), and (2) by forming a thin protective coating on the surface of the distilled Ca, through the introduction of CO_2 into the retort cooled to 300°C; the latter can then be opened and the metal handled preparatory to the second distillation and the hydrogenation. The patent covers several modifications of the method that concern details and materials used.

1070 Preparation of Alkali Metal Borohydrides. Hermann I. Schlesinger (to U. S. Atomic Energy Commission). U. S. Patent 2,461,663, Feb. 15, 1949.

Borohydrides of the alkali metals can be prepared from alkali-metal tetraalkoxyborates and diborane, the reaction being $3MeB(OR)_4 + B_2H_6 \rightarrow 3MeBH_4 + 4B(OR)_3$, where Me is an alkali metal and R is a monovalent alkyl radical. The $MeB(OR)_4$ may be formed by reaction of alkyl borates with alkali-metal alkoxides. The reaction between $MeB(OR)_4$ and B_2H_6 is carried out in a closed system, the absence of air being essential. The following specific example illustrates the method. $KB(OCH_3)_4$ in the amount of 7.3 g was introduced into a reactor comprising a heat-resisting glass tube; the reactor, evacuated and cooled by liquid N, was connected to a cooled closed bulb containing solid B_2H_6; by raising the temperature of the bulb, gaseous B_2H_6 entered the reactor; as the temperature of the latter rose from −80°C, the reaction proceded vigorously; the reactor was then permitted to stand at room temperature for two days to bring about the completion of the reaction, after which heating for several hours at 190°C insured the elimination of all volatile materials, the KBH_4 remaining as a solid residue, (90% yield). Sodium and lithium compounds are obtained in an analogous way.

1071 Preparation of Alkali Metal Compounds. Hermann I. Schlesinger and Herbert C. Brown (to U. S. Atomic Energy Commission). U. S. Patent 2,461,661, Feb. 15, 1949.

Alkali-metal borohydrides, used as reducing agents, are prepared from alkali-metal alkoxyborohydrides and diborane, according to equation $2MeBH(OR)_3 + B_2H_6 \rightarrow 2MeBH_4 + 2B(OR)_3$, where Me is an alkali metal and R is a monovalent alkyl radical. Diborane is obtained by the reaction of MeH and a boron halide in the presence of an ether, (described in claim Serial No. 605,618, filed July 17, 1945), while $MeBH(OR)_3$ is prepared by the addition reaction of MeH and $B(OR)_3$, an ester of boric acid and a monohydric alcohol. In an example cited 2,300 g of $B(OCH_3)_3$, (boiling point 68°C), were gradually added to 480 g of NaH, then maintained at a reflux at 68°C for 6 hr; the $NaBH(OCH_3)_3$ formed was a crystalline mass, slowly affected by moist air, (melting point ~ 230°C). An example of the main reaction is the preparation of sodium borohydride $NaBH_4$. Low temperature and absence of air are essential in these reactions, conducted in a closed system. $NaBH(OCH_3)_3$ in the amount of 0.146 g was placed in a reactor, evacuated and cooled to −196°C by liquid N; the reactor was connected to a cooled closed bulb containing solid B_2H_6; by raising the temperature of the bulb, gaseous B_2H_6 entered the reactor; the temperature of the latter was raised and the reaction began at −80°C and ended, in about 15 min, at 25°C; the yield was about 80%. The product is a fine white powder, soluble in liquid ammonia and pyridine, readily attacked by acids, and slowly by water; it is a good reducing agent: many metal salts in aqueous solution are reduced to free metal; nickel sulphate gives a precipitate of Ni_2B. Similar properties show $LiBH(OCH_3)_3$, prepared in an analogous way.

1072 Preparation of Alkali Metal Compounds. Hermann I. Schlesinger and Herbert C. Brown (to U. S. Atomic Energy Commission). U. S. Patent 2,461,662, Feb. 15, 1949.

A method is given for the preparation of alkali-metal borohydrides from an alkali-metal alkoxide and diborane, according to the equation $3MeOR + 2B_2H_6 \rightarrow 3MeBH_4 + B(OR)_3$, in which Me is an alkali metal and R is a monovalent alkyl radical. Diborane is obtained by the reaction of an alkali-metal hydride and a boron halide in the presence of an ether, as described in a separate application Serial No. 576,502, filed Feb. 6, 1945. The main reaction, as outlined above, is carried out in a closed system provided with an agitator and adequate distillation and evacuation equipment; the absence of air is essential. In a specific example, 0.19 g of $NaOCH_3$ was placed in the reactor, evacuated and cooled to −196°C by liquid N; the reactor was connected to a cooled closed bulb containing solid B_2H_6; by raising the temperature of the bulb, gaseous B_2H_6 entered the reactor; the temperature of the latter was raised and the reaction, which is exothermic, began at −80°C and ended at 25°C; the yield of the solid product was about 83%. Lithium borohydride is prepared in an analogous way.

1073 Preparation of C^{14} Uniformly Labeled Fructose by Means of Photosynthesis and Paper Chromatography. Sidney Udenfriend and Martin Gibbs. Science 110, 708-9(1949) Dec. 30.

After trifoliate bean leaves had been allowed to photosynthesize in the presence of 2.8 mc of $C^{14}O_2$, they were killed in hot 80% alcohol, and the alcohol extract, which was known to contain sucrose, glucose, and fructose as well as other alcohol-soluble substances, was ether extracted; after passage through ion exchange columns and repassage following sulfuric acid hydrolysis, most of the glucose was crystallized out and the remaining glucose was separated from the fructose by a chromatographic technique. The fructose bands were identified with radioautographs, cut out and pooled; about 10 mg of

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the fructose was eluted from the pooled chromatographic strips by boiling the paper in 80% alcohol, then treating by Soxhlet extraction for 5 hr. The alcohol was removed by distillation and water was added; the aqueous solution was then extracted in ether and passed through an ion exchange apparatus, and the resultant solution was concentrated to a small volume. The fructose was then removed from the resultant mass by crystallization, involving seeding with nonradioactive fructose and centrifugation. It is concluded that many groups of compounds other than sugars may be subjected to chromatographic separation.

1074 Preparation of Radioactive Cyanide from Carbon Dioxide. Richard Abrams. J. Am. Chem. Soc. 71, 3835-6(1949) Nov. (Note).

A method found to be satisfactory for the conversion of $BaC^{14}O_3$ to $HC^{14}N$, based upon the reduction of carbon dioxide with magnesium powder and the conversion of amorphous carbon to hydrocyanic acid with ammonia gas at 1000°, is given in detail. Yields are usually between 60 and 70% and not particularly dependent upon carbon dioxide pressure or magnesium excess.

1075 Preparation of a Radioactive Oxazine Dye. Henry A. Sloviter. Science 110, 687-8(1949) Dec. 23. (See also NSA 4-55.)

The oxazine dye known as Nile blue 2B has a great affinity for tumor tissue. A chemical method is described by which a radioactive iodine derivative of this dye was prepared, using the tracer isotope I^{131}, the resultant activity being 0.55 mc/g. The radioactive dye was then administered to tumor bearing animals and to a small number of human subjects. Its effects are reported elsewhere (Cancer Research 9, 677(1949)).

1076 The Preparation of 3,4,5-d_3-Lithocholic Acid. W. H. Pearlman, M. R. J. Pearlman, and S. Elsey. J. Am. Chem. Soc. 71, 4126-7(1949) Dec.

3,4,5-d_3-Lithocholic acid, containing 3.89 at.% excess deuterium, has been prepared by catalytic deuteration of methyl $\Delta^{4,5}$-3-ketocholenate in two steps. In addition, 3(β)-hydroxyallocholanic acid and 3(β)-hydroxycholanic acid were obtained. The isotopically labeled bile acid should prove useful for metabolic study.

1077 Radiomicrosynthesis by Nuclear Isomers. Action of Radiobromine on Benzene and Naphthalene. Relation with the Free-Valence Index. Serge May, Monique Roux, Buu-Hoï, and Raymônd Daudel. Compt. rend. 228, 1865(1949) June 13 (in French).

Under the influence of the nuclear-isomeric Szilard effect, molecules containing Br^{80} (4hr 50 min) throw out the isomer Br^{80} *(18 min) which can be employed as a brominating agent (Daudel et al, J. chim. phys. 45, 182(1948)); the yield of the compound obtained is easily determined by measuring the 18-min activity. Such a bromination of benzene and naphthalene by radioactive ethyl bromide is described here. After several minutes of contact, the ethyl bromide is removed from the mixture by distillation; the two reaction products

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are separated with the aid of carriers. Since in the initial mixture the molar ratio between C_6H_6 and C_8H_{10} was 5:1, and the ratio between activities of the final bromobenzene and bromonaphthalene was found to be 1:2, the ratio between the probabilities of bromination of C_8H_{10} and C_6H_6 is $2 \times 5 \times 6/8 \cong 7$, in good agreement with the fact that the free-valence indexes of the summits in the naphthalene formula are greater than those in benzene (Daudel et al, Compt. rend. 220, 599(1945)).

1078 16-C^{13}-Dehydroisoandrosterone Acetate. E. B. Hershberg, Erwin Schwenk, and Elsie Stahl. Arch. Biochem. 19, 300-10(1948) Nov.

The preparation of 3-hydroxyetiobilienic acid by hypoiodite oxidation of dehydroisoandrosterone was studied and a new intermediate iodine compound was isolated. The preparation of diazomethane containing the isotope C^{13} is described in detail and the synthesis of 16-C^{13}-dehydroisoandrosterone acetate is presented.

1079 A Synthesis of Alanine Labeled with Heavy Carbon in the α Position. J. Baddiley, G. Ehrensvard, and H. Nilsson. J. Biol. Chem. 178, 399-402(1949) Mar.

A synthesis of benzoyl-DL-alanine labeled with C^{13} in the α carbon position from labeled sodium cyanide is described. Resolution and hydrolysis produced the corresponding pure D- and L-alanines. 16 references.

1080 Syntheses of Isotopically Labeled 2,4-Dichlorophenoxyacetic Acid (2,4-D) and Derivatives. Henry R. Mahler, R. J. Speer, and Ammarette Roberts. Science 110, 562(1949) Nov. 25.

Radioactive isotopes were used to synthesize 2,4-dichlorophenoxyacetic acid and some of its derivatives. One synthesis employed I^{131} and yielded 2,4-dichloro-5-iodophenoxyacetic acid through a series of reactions in which the 5-amino compound was synthesized, diazotized and treated with radioactive sodium iodide. A method is described also for the preparation of 2,4-dichlorophenoxyacetic acid-1-C^{14} by chlorinating potassium acetate-1-C^{14} in nitrobenzene, using a modification of Ostwald's synthesis (J. Biol. Chem. 173, 207(1948)). Alkaline condensation of the chloroacetic acid with 2,4-dichlorophenol then gives the desired product. A yield of 0.68 g of C^{14} labeled 2,4-D is obtained.

1081 The Exchange between a Formamido Group and Formamide, Studied with C^{13}. Liebe F. Cavalieri and George Bosworth Brown. J. Am. Chem. Soc. 71, 2246-7(1949) June (Note).

Adenine (I) may be prepared by heating 4,6-diamino-5-formamidopyrimidine (II) in formamide (Cavalieri et al, J. Am. Chem. Soc. 71, 533(1949)). In order to prepare adenine labeled with C^{13} in the 8-position, 4,5,6-triaminopyrimidine (III) as the sulfate was converted to II by formylation with C^{13} labeled formic acid. When the sulfate of II was heated in formamide, extensive exchange with the formamide occurred and only 25% of the carbon isotope contained in II was found

in the adenine (I) which resulted. Formamide decomposes to ammonia and carbon monoxide when heated (Freer and Sherman, Am. Chem. J. 20, 223(1898)) and it is probable that the mechanism for the exchange involves ammonolysis of the formyl group (Bendich et al, J. Am. Chem. Soc. 70, 3109(1948)). Evidence in support of this mechanism is found in the fact that the triamine (III) when heated with formamide is converted to adenine in 62% yield. Further, it appears that once the adenine is formed it remains intact, since a sample of adenine subjected to the reaction conditions was recovered in quantitative yield (95%).

1082 The Exchange of Chlorine Dioxide with Chlorite Ion and with Chlorine in Other Oxidation States. Harold Dodgen and Henry Taube. J. Am. Chem. Soc. 71, 2501-4(1949) July.

Since chlorine dioxide and chlorite ion differ principally only in their charge, it may be expected that electron transfer will occur on the close approach of $ClO_2 + ClO_2^-$. This was borne out by studies reported here using Cl^{36} (half-life 37 min). It was found that a rapid exchange between ClO_2 and ClO_2^- takes place in acid and neutral solution (aqueous solutions). At high dilutions (concentrations about 10^{-4}M) the rate of exchange is slow enough to be measurable. ClO_2 does not exchange at an appreciable rate with ClO_4^-, ClO_3^-, Cl_2 or Cl^-. In the presence of HOCl, the oxidation of ClO_2 to ClO_3^- takes place fairly rapidly. In addition to this net chemical change, a slow exchange between HOCl and ClO_2 takes place.

1083 The Exchange of Mercury(I) and Mercury(II) Ions. Edward L. King. J. Am. Chem. Soc. 71, 3553-4 (1949) Oct. (Note).

The exchange of mercury(I) and mercury(II) ions in solution was studied using $Hg^{203,203}$. The separation of the two oxidation states was effected by the precipitation of mercury(I) chloride, mercury(I) chromate, and mercury(I) sulfate. It was observed that the bond in dimeric mercury(I) is apparently readily broken, and that mercury(I) ion diffuses approximately 10% more rapidly than mercury(II) under certain concentration conditions. The condition under which this separation was achieved ($(Hg_2^{++})_o/(Hg^{++})_o = 0.5$) was such that the counting rate of the diffusate would vary by only 5% depending upon whether the extent of exchange was 0% or 100%. The analytical and counting rate uncertainties were such that it does not appear worthwhile to use this technique in exchange studies.

1084 The Exchange Reaction between Antimony(III) and Antimony(V) in Hydrochloric Acid Solutions. Norman A. Bonner. J. Am. Chem. Soc. 71, 3909-14(1949) Dec.

The 60-day Sb^{124} was used in a preliminary study of the exchange reaction between Sb(III) and Sb(V) in HCl solutions. The kinetics of the exchange were studied in 6 f HCl, and in addition, the rates of exchange were measured in 3 f and 12 f HCl. In 6 f acid, half-times in the neighborhood of 60 hr were observed and the rate was found to depend critically on the HCl concentration. It was found that the rate law at

25.0°, with H^+ concentrations from 4.7 f to 6.1 f, Cl concentration from 5.4 f to 6.1 f, Sb(III) concentrations from 0.0008 f to 0.040 f, Sb(V) concentrations from 0.0008 f to 0.0040 f and Na^+ concentrations from 0.0 f to 0.8 f is $R = (8.8 \pm 0.9) \times 10^{-11}\ (Sb(III))^{0.6}\ (Sb(V))^{1.1}\ (H^+)^4\ (Cl^-)^9$ mole $\times$ liter$^{-1} \times$ hr^{-1}. In the same ranges of concentrations the experimental activation energy is 27 ± 2 kcal/mole (measurement made at 9.8, 25.0 and 34.6°). In 12.0 f HCl at 25.0° the half-time for exchange is 36.2 min with an antimony(III) concentration of 0.0235 f and an antimony(V) concentration of 0.0198 f.

1085 Fermentation of Glucose-1-C^{14}. Daniel Koshland, Jr., and F. H. Westheimer. J. Am. Chem. Soc. 71, 1139(1949) Mar. (Letter to the editor).

In a study of the fermentation of d-glucose-1-C^{14} the prediction, (Meyerhof, Biochem. Symposia 5, 141(1941)) that all the radioactive carbon will appear in the methyl group of the alcohol so obtained, was substantially confirmed. However, it was seen (by control experiments on the pyrolysis of methyl-labeled acetic acid) that 0.1-0.3% of the activity occurred in the $BaCO_3$ produced.

1086 Isotopic Tracer Elements and Stereochemistry. Philip E. Wilcox. Nature 164, 757(1949) Oct. 29 (Letter to the editor).

The author has proposed a general rule which may be useful in tracer experiments with asymmetric reagents, whether or not these reagents are enzymes. The rule applies to any "partial asymmetric synthesis" or decomposition, and reads as follows: In a molecule which has a plane of symmetry or a point of symmetry, if one of the atoms which does not lie in any plane or point of symmetry is replaced by an isotopic atom, the molecule becomes asymmetric with respect to the labeled atom. In any reaction with an asymmetric reagent, this labeled atom (or group) may react at a rate which is different from that of its counterpart through the plane or point of symmetry, and the difference in rates will be expressed in the distribution of the isotope in the products. This asymmetric behavior would be superimposed on any difference in the rates of reaction which would result from the different masses of the isotopic atoms. The stereoisomerism which leads to this behavior might be called "isotopic pseudoasymmetry."

1087 Starch Blue. Naomi C. Turner. Science 108, 302 (1948) Sept. 17 (Communication).

Radioactive iodine was used to investigate the reason for the blue color when starch and iodine are mixed together. To 2 ml of a 1% corn-starch solution, 2 ml of iodine solution and 10 μc of I^{131} were added. After allowing contact for 3 hr, iodine was withdrawn by repeated butanol extraction; the butanol was found to contain the radioactive iodine, while no radioactivity was found in the starch blue. It is concluded that the change leading to blue color is a change induced in the starch molecule by iodine acting catalytically in the presence of oxygen and that the blue color is not dependent on the presence of iodine.

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1088 Reactions of Polyfluoro Olefins. III. Preparation of Polyfluoro Ethers. John T. Barr, Karl E. Rapp, Roy L. Pruett, Carl T. Bahner, J. Donald Gibson, and Robert H. Lafferty, Jr. K-535, Dec. 23, 1949. 12p.

The base-catalyzed addition of allyl and t-butyl alcohols to chlorotrifluoroethylene and the properties of the resulting chlorotrifluoroethyl ethers are described. Alcohols and hexafluorocyclobutene reacted to give mono- and dialkoxy polyfluorocyclobutenes. By proper choice of catalyst and reaction conditions, it was found possible to control the relative amounts of the products produced. An addition mechanism is proposed for this reaction and supporting evidence is given. Only monoaryloxycyclobutenes were obtained from the reaction of phenolic compounds and hexafluorocyclobutene. (auth)

1089 Physical Properties of Chlorotrifluoroethylene Polymers—A Summary for Practical Applications. W. H. Reysen and J. D. Gibson. K-538, Dec. 23, 1949. 13p.

The relationships between molecular weight, viscosity, density, and vapor pressure of a selected number of fractions of chlorotrifluoroethylene liquid polymers are summarized in tabular and graphical form for temperatures between 100° and 210°F. Convenient methods are provided and illustrated for applying this information to lubrication and oil blending problems. The methods used to determine the physical properties of these oils are outlined briefly. References included.

1090 Apparatus for the Storage of Fluorine. H. F. Priest (to Office of Scientific Research and Development, Office for Emergency Management). U. S. Patent 2,419,915, Apr. 29, 1947.

This invention describes an easily transportable fluorine gas storage vessel containing a lining and unreactive protective coating resistant to the fluorine gas. The surface surrounding the storage space and the continuous, adherent coating on the inner surface consist of copper, nickel, or a copper-nickel alloy with a copper content of more than 60%. The reactive product contained on the inner surface is the metal fluoride, which is impenetrable and resistant to the fluorine gas.

1091 Boron Trifluoride and Its Derivatives. Harold Simmons Booth and Donald Ray Martin. New York, John Wiley and Sons, 1949. 315p.

This is an exhaustive monograph on boron trifluoride, which deals with the following topics: the physical and chemical properties of BF_3, its coordinating power, the fluoboric acids and salts, BF_3 and its derivatives as catalysts, the analysis of BF_3 and its derivatives and the practical handling of BF_3. An extensive bibliography consisting of 973 references is appended.

1092 Chlorinated Hydrocarbon. Melvin A. Perkins (to United States Atomic Energy Commission). U. S. Patent 2,485,507. Oct. 18, 1949.

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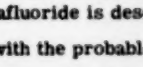
This invention describes a method of manufacture of highly chlorinated organic compounds containing eight carbon atoms from chlorinated hydrocarbons of lower molecular carbon content; the process is adapted for the production of new high-boiling oils suitable for use as heat transfer media and as intermediates for the manufacture of other highly halogenated products. The octachlorohexene obtained by condensing or dimerizing in the presence of a Friedel-Crafts condensing agent two molecules of a tetrachloropropene having one hydrogen only in the 1-position, is further condensed with trichloropropene in the presence of a Friedel-Crafts condensing agent; by-products containing 5, 6, 7 and possibly 9 carbon atoms are obtained. The condensation of two molecules of 1,2,3,3-tetrachloropropene (proceeding at ordinary room temperature or at slightly elevated temperatures) results in the formation of normal 1,2,3,4,5,5,6,6-octachlorohexene-1, and upon condensation of this product with trichloroethene, a replacement of the chlorine in the 3-position takes place, and this chlorine migrates to the remaining free bond of the ethylene radical to form the chlorinated 3-ethyl-hexene-1 having the formula:

$$CHCl{:}CClCHClCHClCCl_2CHCl_2$$

$$CHClCCl_3$$

This compound is claimed as a new product of manufacture.

1093 Fluorination of Perchlorohexatriene. William S. Struve (to United States Atomic Energy Commission). U. S. Patent 2,431,969, Dec. 2, 1947.

The product of fluorination of perchlorohexatriene with antimony pentafluoride is described, the new compound being C_6ClF_9 with the probable skeleton ring  .

Perchlorohexatriene (melting point 184°C) is obtained by heating perchloropropene with cuprous chloride in ethanol at 35°C for 26 hr. A mixture of 300 parts by weight of perchlorohexatriene and 1,500 parts of crude SbF_3 was heated in an autoclave at 180°C for 3 hr; the product was drowned in a mixture of ice and water and the organic layer was washed and distilled; the fraction 74.5-76°C, amounting to 60 parts by weight, was the fluorination product, an inert, clear, colorless oil, having a density 1.67 (20°/20°) and a refractive index 1.32 (sodium D line). It can be used as a volatile inert solvent for halogenated organic compounds, as a liquid reaction medium, and as a heat transfer medium.

1094 Joint Fillers. Travis W. Stricklin (to United States Atomic Energy Commission). U. S. Patent 2,446,251, Aug. 3, 1948.

The inventor claims a permanently plastic pipe joint compound, having lubricating properties, which is highly resistant to attack by elemental fluorine. This compound is useful for application to threaded unions of pipes used for conveying gaseous fluorine. This filler consists of a mixture of calcium fluoride with a perfluorated lubricant in proportions specified by the inventor.

1095 Liquid Level Measuring Apparatus. M. K. Richards (to United States Atomic Energy Commission). U. S. Patent 2,486,207, Oct. 25, 1949.

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A simple means for measuring the liquid levels in vessels containing two gas compartments above the same body of fluid is described; it consists of a gas bubbler suitable for application in systems involving highly corrosive materials such as the fluorine, hydrogen fluoride, and acid potassium fluoride electrolyte involved in the electrolytic production of fluorine. The gas compartments to be measured are connected to manometers which are in turn connected to a single gas feed to the body of liquid beneath the compartments. The manometers measure the difference in pressure between the gas spaces and the gas feed; since the same liquid body is beneath both gas spaces, the liquid level in each space corresponds to the gas pressure and the difference between the pressure of the gas feed and that of each of the gas spaces constitutes a direct measure of the height of the liquid column from the gas feed to the liquid level in that particular compartment. The gas feed may be made up of any suitable inert gas. In the fluorine electrolyte systems an absorber for the removal of elemental fluorine is placed between the manometer and the gas compartments.

1096 Production of Fluorine. Walter C. Schumb and Arthur J. Stevens (to Director, Office of Scientific Research and Development). U. S. Patent 2,422,590, June 17, 1947.

The present invention has as an object the improvement of the electrolytic production of fluorine, so as to do away with the the need for large amounts of heat without requiring the use of an electrode of nickel or other rapidly consumed (by the fluorine) expensive metals. A method is provided for running the electrolytic decomposition of hydrogen fluoride below 100°C and consists of the addition of small amounts of lithium fluoride to electrolytes of the type comprising hydrogen fluoride and a fluoride of a univalent metal, such as potassium. The primary effect of the lithium fluoride is to lower the melting point to a marked degree; this allows the graphite type of anode to be used, and reduces the vaporization loss of the hydrogen fluoride by lowering its vapor pressure. The system should be composed of 70-90% potassium bifluoride (preferably 81.7% by weight), 8-20% hydrogen fluoride (preferably 14.3% by weight), and up to 10% lithium fluoride (preferably 4% by weight).

1097 Purification of Acid Potassium Fluorides. Paul R. Johnson (to Director of the Office of Scientific Research and Development). U. S. Patent 2,422,907, June 24, 1947.

The present invention has for its object the removal of iron present in acid potassium fluorides used as electrolytes in the manufacture of fluorine in iron or steel electrolytic cells. The corrosive action of the electrolyte gradually dissolves the iron of the equipment, and the growing iron concentration in the electrolyte reduces the current efficiency of the cell. To remedy this, the author proposes a periodic purification of such electrolytes with normal or acid sodium fluoride. By adding this salt to a molten mass of contaminated acid potassium fluoride (at about 100°C), a precipitate is formed, consisting probably of the triple salt $NaF.2KF.FeF_3$. Iron impurities, that may reach as much as 7% by weight, can be reduced to 0.3 to 0.5%. The precipitate eliminates also impurities suspended in the electrolyte, such as insoluble salts of iron, copper, and nickel.

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1098 Purification of Hydrogen Fluoride. Robert H. McBride (to United States Atomic Energy Commission). U. S. Patent 2,468,681, Apr. 26, 1949.

This invention is concerned with the removal by a new solvent extraction process of fluorinated organic impurities from the by-product hydrogen fluoride created in the synthesis of perfluoro-dimethyl-cyclohexane from bis (trifluoromethyl) benzene; the solvent extraction process consists of washing out the impurities with an organic solvent selected from the group consisting of perfluoro-methyl-cyclohexane and perfluoro-dimethyl-cyclohexane. The hydrogen fluoride containing the impurities is measured into a copper flask which is then cooled in acetone and solid carbon dioxide before the solvent is added; after shaking for several minutes, the layers are allowed to separate and the layer containing the extracted organic impurities is carefully poured off. It is concluded that the hydrogen fluoride which has been purified in this manner is sufficiently free of the organic contaminants to be utilized in an electrolytic cell for generating fluorine.

1099 Purification of Perfluoroheptane by Azeotropic Distillation with Methyl Ethyl Ketone. Latimer R. Evans and Henry B. Hass (to United States Atomic Energy Commission). U. S. Patent 2,442,589, June 1, 1948.

Perfluoroheptane is often prepared by first chlorinating n-heptane, then by fluorinating the resulting compound. However, the product thus obtained contains chlorine-organic admixtures (2-7%), which it has been impossible to eliminate by simple rectification. The process of purification described in the present patent is a distillation of chlorine-containing perfluoroheptane with methyl ethyl ketone, whereby an azeotropic fraction, distilling at 62-63°C, is obtained that is practically free of chlorine; (the initial product distills at 80-85°C); perfluoroheptane is then separated from the ketone by decantation. The process comprises several steps, including two distillations in fractionating columns and three decantations; for further purification the product is washed with aqueous $NaHSO_3$ solution and subjected to distillation without the addition of an azeotropic agent.

1100 Safe Handling of Fluorine Chemicals. Henry C. Miller. Chem. Eng. News 27, 3854-7(1949) Dec. 26.

The chemistry and physiological effects of fluorine and its compounds are described: specifically treated are the insoluble fluorides, soluble neutral fluorides, acidic fluorine chemicals, oxidizing fluorine compounds, organic fluorine compounds, inert fluorine gases, and hydrofluoric acid. The author asserts that fluorine compounds can be handled with relative safety, provided the specific hazards involved are recognized. The symptoms of poisoning are pronounced and easily recognized, and after the original effect has passed, chronic symptoms are rare. Urinalysis and x-ray examination are indicated as measures of the amount of absorption of the compounds.

1101 Attempted Reduction of Neodymium to the Divalent State. H. A. Laitinen and Eva Blodgett. J. Am. Chem. Soc. 71, 2260-1(1949) June (Note).

A reinvestigation of the reduction of rare earth sulfates with strontium amalgam was carried out with a view toward possi-

ble applications in rare earth separations. Neodymium and ytterbium were studied.

1102 Chemistry of the Rare Earths. Part VI. Double Thiosulphate of Rare Earths. Nihar Kumar Dutt. J. Indian Chem. Soc. 26, 405-14(1949) Sept.
Investigations were made of the composition and nature of the thiosulfates of the rare earths. The composition was studied by two independent physical methods: the method of thermometric titration of Dutoit (J. chim. phys. 19, 324, 331(1921)) and the method of continued variation of Job (Compt. rend. 180, 928(1928)). The first method gave curves for the cerium earths which were all of the same type; multilinear with two breaks each. The first break with the different rare earths and thiosulfate was always in the same region where the ratio $R:S_2O_3 = 2.3$, corresponding to the formation of normal thiosulfate $R_2(S_2O_3)_3$, where R stands for La, Ce, Pr, and Nd. The position of the second break in the curve differed much for the different alkali thiosulfates. The method of continued variation gave curves which were all alike, however, showing breaks in the regions corresponding to the normal thiosulfate and the complex ion $R(S_2O_3)_4^{+3}$ showing that at the dilutions studied only one type of complex ion exists. The composition of the complex was studied further by isolation of the salts in the solid state and subsequent chemical analysis. 7 tables.

1103 Halide Catalysis in the Reaction of Cerium (IV) with Arsenic (III). Robbin C. Anderson, James A. Lasater, and David Lippmann. J. Am. Chem. Soc. 71, 2577-8(1949) July (Note).
Experiments were undertaken to obtain quantitative data on the rate effects of small concentrations of halides in the oxidation of arsenite by cerium. Equivalent quantities of cerium (IV) sulfate and sodium arsenite were used. The addition of chloride, bromide, and iodide had a definite catalytic effect even at very low concentrations. In general, the order of effectiveness as catalysts is $I^- > Br^- > Cl^-$.

1104 Industrial Chromatography. Part II. Industrial Chromatography of the Rare Earths. Herbert Weil. Can. Chem. Process Inds. 33, 1036-42, 1082-7(1949) Dec.
The transition of chromatography from an analytical method to a unit-operation in the rare earths industry is set forth. The importance and properties of the rare earths, and their separation by chromatography are given comprehensive treatment; applications of recently designed equipment as well as uses of some of the rare earths are listed. 69 references.

1105 On the Existence of the Higher Oxides of Neodymium. Alexander I. Popov and George Glockler. J. Am. Chem. Soc. 71, 4114-15(1949) Dec.
The work of earlier investigators was repeated in an attempt to clarify the question of the existence of the higher oxides of Nd. A product claimed to be neodymium dioxide was identified as basic neodymium oxide NdO(OH). This seems to indicate that the earlier reports of the existence of the higher oxides of Nd were due to the use of impure

compounds or to the mistaken identity of the basic oxide. The trivalent state of Nd appears to be the highest oxidation state observed so far.

1106 The Separation and Purification of Lanthanum. Part II. Nitrate Fusion: Solubility of Rare-earth Hydroxides in Fused Ammonium Nitrate. R. C. Vickery. J. Chem. Soc., 2508-11(1949) Oct.
Studies of the solubility of rare-earth hydroxides in fused ammonia nitrate show that solubility is in the same relationship as basicity, although yttrium appears to find a place higher in the series than hitherto recorded. By applying ammonium nitrate fusion to the separation of hydroxide mixtures it is found that a very good and fairly clean separation is obtained of lanthanum from its congeners. The influence of cerium in the fusion is studied, and its separational effect confirmed. Ammonium nitrate fusion also appears to be a method for the removal of erbium from yttrium.

1107 The Separation of Rare Earth Elements, Particularly Praseodymium and Neodymium. W. T. Ziegler. Research Eng. No. 3, 7-10(1949) Nov.
The author briefly surveys the subject of the rare earths and their separation, and describes Georgia Institute of Technology research on the separation of neodymium, praseodymium, and lanthanum. The separation of rare earths by the ion exchange method is briefly described.

1108 Spectrochemical Determination of Lanthanum in Praseodymium Metal. William M. Spicer and Waldemar T. Ziegler. Anal. Chem. 21, 1422-3 (1949) Nov.
A spectrographic method of analysis for lanthanum is described. The copper spark method (Fred et al, J. Optical Soc. Am. 37, 279(1947)) was used because it requires only a very small sample and avoids the formation of cyanogen bands which mask many important lanthanum lines. Manganese was used as an internal standard. From five repeat determinations a mean value of 37.0% for lanthanum content was obtained. The average deviation from the mean corresponds to a variation of 1.7% in the lanthanum content of the praseodymium metal, or 4.6% in the analysis of the sample.

1109 Studies of the Rare-earth Tungstates. R. C. Vickery. J. Chem. Soc., 2501-5(1949) Oct.
When precipitated from solution, tungstates of the higher group of lanthanons (the designation "lanthanons" proposed by Marsh (Quart. Reviews 1, 126(1947)) is used here synonymously with "rare earths") (La, Ce, Pr, Nd, Sm) appear amorphous and show previously undescribed color changes on ignition. These are attributed to partial reduction to tungstites of varying composition which are finally reoxidized to stable crystalline tungstates. These phenomena are studied and it is concluded that the precipitated tungstates have the generic formula $Ln_2O_3,3(H_2WO_4)$, being converted into the generally accepted $Ln_2(WO_4)_3$ structure only on heating.

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1110 The Transuranium Elements. Glenn T. Seaborg, Joseph J. Katz, and Winston M. Manning, Eds. New York, McGraw-Hill Book Company, Inc., 1949. 1733p. (in 2 parts). NNES Div. IV, Vol. 14B.

This volume contains more than 150 original research papers dealing with the physical and chemical properties of the transuranium elements and their isotopes. Some of the papers included cover investigations begun as early as 1940, most of them are the product of research during the war years, while a number deal with recent post-war work. Sixty-five per cent of the papers are devoted to plutonium 94, 10% to neptunium 93, 5% to americium 95 and curium 96, and 10% to related topics (α particles, uranium, radium, etc.) which are included for reference. The editors refrained from extensive editorial work on the individual papers, which are given, except for the elimination of errors from the text, essentially as written originally, so that discrepancies occur in various papers treating the same subject. It is stated that the authors of the individual articles must accept the primary responsibility for the presentation, accuracy of results and conclusions. Included in the volume are a number of papers of historical interest which give nuclear constants now superseded by more accurate values. In order to provide background which may not be obtainable from the papers alone, there are presented brief historical surveys of the outstanding developments concerning the transuranium elements.

1111 Theoretical Consideration of the Ether Extraction of Uranyl Nitrate from Aqueous Solutions Containing Various Metal Nitrate Salting Agents. L. I. Katzin and N. N. Hellman. AECD-2758, Nov. 20, 1947, Decl. Dec. 19, 1949. 22p.

On the hypotheses of (a) strong electrolyte behavior of uranyl nitrate, (b) reaction of ether with hydrated uranyl nitrate to give a compound containing one molecule of ether with loss of three waters, and (c) extraction of the resulting hydrate-ether etherate into the organic phase, an equation has been derived for the distribution of uranyl nitrate between water and ether. Test of the relationship has been made with data available for the extraction of trace concentrations of uranyl nitrate from strong salt solutions. Within the limits of accuracy of the data used, the relationship shows distinct promise. (auth)

1112 Determination of Small Amounts of Uranium. IV. Spectrophotometric Determination of Uranium with Cyanoferrate(II). Sten Ahrland. Svensk Kem. Tid. 61, 197-203(1949) Sept.

A report is given of the development of a spectrophotometric method, using a Pulfrich photometer, for the determination of uranium in extremely dilute solutions of uranyl nitrate (concentrations < 100 mg U/l), which also contain nitric acid and traces of other heavy metals, especially iron. After determination of the spectral range most convenient for the determination of uranium (4600-4800 A where the U extinction is great and Fe extinction has a minimum) known amounts of Fe^3 were added to uranium solutions of different concentrations. Results show that 10% of Fe^3 by weight may be present without danger. The applicability of the method depends on whether the method of separation of uranium used is sufficiently effective so that this limit is not exceeded.

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1113 Determination of Small Amounts of Uranium. V. Spectrochemical Determination in Solutions. Bertil Dahlman and Roland Rynninger. Svensk Kem. Tid. 61, 204-13(1949) Sept.

The present investigation has shown that quantities between 0.05-5 mg of uranium can be determined spectrochemically in pure solutions of uranyl nitrate, using iron as internal standard element. The spectrograph used was a three-prism glass spectrograph of Zeiss' construction with a camera F:84 cm. The uranyl nitrate solutions are obtained by ether extraction from very complex solutions containing large quantities of other elements. The precision of the method was calculated statistically and the standard deviation was found to be ±7% of the uranium concentration. By a slight modification of the method, uranium quantities between 0.005 and 0.5 mg can be determined with the same accuracy.

1114 Meeting of the Optical Society of America, Held on Oct. 27-29, 1949, at Buffalo, New York. Anal. Chem. 21, 1585-7(1949) Dec.

The following two papers were among those presented at the meeting: Fluorophotometric Determinations of Uranium, George R. Price, Renato J. Ferretti, and Samuel Schwartz; Fluorescence Studies of Plutonium and Neptunium, George R. Price.

1115 Method of Preparing Uranium Deuteride. A. S. Newton (to United States Atomic Energy Commission). U. S Patent 2,452,139, Oct. 26, 1948.

A method is given for the preparation of uranium deuteride UD_3 from U and D, in a reversible reaction requiring suitable conditions of temperature and pressure. Metallic U is obtained from a mixture of powdered UF_4 and Mg heated in a crucible, in which molten U separates under a layer of slags. The metal must be free from parting planes of oxide. The apparatus for the preparation of UD_3 is a closed system composed of two parts: in part one, vapors of heavy water react with uranium turnings at ~700°C to form D; in part two, D reacts with uranium turnings at ~250°C to form UD_3. The pressure should not exceed the decomposition pressure of UD_3, which is ~27mm Hg at the above temperature. The UD_3 forms a black powder falling off the metal and exposing fresh metallic surfaces all through the reaction; the end is indicated by the rising pressure. The patent claims include several variants in the details of the procedure and in the nature and form of the reagents. The final product UD_3 is a convenient means of storing and handling D, the latter being released by heating above the decomposition temperature at the existing pressure.

1116 Method of Preparing Uranium Hydride. Amos S. Newton (to United States Atomic Energy Commission). U. S. Patent 2,446,780, Aug. 10, 1948.

A method for the preparation of uranium hydride is described. It consists of the introduction of water vapor into the first of two communicating reaction zones present within a closed system, maintained below atmospheric pressure; the water vapor is reduced by a suitable substance to hydrogen, which is transported to the second zone of reaction and reacted with metallic uranium at prescribed pressure

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and temperature conditions. The reaction rate of the system is controlled by the rate of introduction of the water vapor, and is so regulated as to provide the second zone continuously with subatmospheric pressures.

1117 Process of Producing Uranium Tetrabromide. J. M. Carter (to United States Atomic Energy Commission). U. S. Patent 2,469,916, May 10, 1949.

This invention pertains to the preparation of uranium tetrabromide by a liquid phase reaction of a uranium oxide (usually uranium dioxide) with sulfur bromide; the reactive sulfur bromide is formed in situ by agitating and refluxing a mixture of the uranium oxide, bromine, and sulfur at an elevated temperature (usually about 170°C), which may vary considerably (140-190°C). The object of this invention is to provide an easier, more efficient and more economical way of producing the tetrabromide and to obviate the difficulties which arise when uranous-uranic oxide is used as the starting material. The apparatus for the reaction consists of a reaction vessel equipped with stirring means, heating means, a reflux condenser, charging ports, and a trap. After the mixture is refluxed for some time, some of the contaminants (sulfur bromide and excess bromine) are distilled out of the reaction mass; the excess sulfur is then extracted from the mass with a solvent and the uranium tetrabromide is isolated.

1118 Uranium Monocarbide and Method of Preparation. Harley A. Wilhelm and Adrian H. Daane (to United States Atomic Energy Commission). U. S. Patent 2,448,479, Aug. 31, 1948.

Uranium carbides of low carbon content (less than 10%) have structural strength and resistance to wear superior to metallic uranium or uranium oxide. A process is shown for the preparation of these carbides, (which may be represented by the formulas UC, UC_2, and U_2C_3), from the oxides UO_2 or U_3O_8 and carbon, mixed in stoichiometric proportions and heated in a crucible below the melting point of the carbide expected. In one of the examples cited a mixture of finely powdered UO_2 and graphite is first pressed under 26 Tsi to the form of a bar 1/2 in. × 1/2 in. × 2 in., which is stood on end in a graphite crucible and heated at ~2,300°C for 20 min; the product, which has the composition $U_1C_{1.27}$, is essentially UC containing some carbon dissolved or dispersed; ($UO_2 + 3C \rightarrow UC + 2CO$). Several variants of the method, which concern the mode of mixing, heating etc., are covered by this patent.

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1119 Experiments in Chromium Electrodeposition with Radioactive Chromium. Fielding Ogburn and Abner Brenner. J. Electrochem. Soc. 96, 347-52(1949) Dec.

A chromic acid bath which has been in production contains some trivalent chromium along with the hexavalent metal. By tagging the chromium in either of the two valence states with radioactive isotope of chromium (Cr^{51}), the radioactivity of the deposit would indicate the valence state from which the metal was deposited. The experiments revealed that the chromium was deposited directly from the hexavalent state.

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1120 Magnetic Pump. Samuel L. Madorsky (to United States Atomic Energy Commission). U. S. Patent 2,481,320, Sept. 6, 1949.

The design of a pump is described which is to be used for the pumping of liquids within regions that are maintained under high vacuum. To make the connection between the pump proper and its power supply leak-proof, the pump is to be operated electromagnetically. By virtue of an improved value mechanism for a magnetically operated pump, the necessity for mechanical connections of any kind is eliminated, since the intake and exhaust valves are arranged in such a way that they are operated by the liquid which is being pumped. Furthermore a reciprocating plunger is provided which is positively driven in but one direction and effects its return stroke by gravity. Consequently, current is consumed by the pump only during a short period of its operation.

1121 The Effect of Cold Work in Metals on Powder Pattern Intensities. B. L. Averbach and B. E. Warren. J. Applied Phys. 20, 1066-9(1949) Nov.

Using crystal monochromated Cu Kα radiation and a Geiger counter spectrometer, integrated intensity measurements have been made for powder samples of cold-worked and annealed α brass. The effect of cold work is to increase the integrated intensity of the strong lines and make practically no change in the weak lines. The increase for the strong lines is presumably due to a reduction in extinction. Measurements were made of the (400) reflection on a cold-worked sample and on an annealed sample held at high temperature to demonstrate the difference between the effects of cold work and temperature vibration.

1122 Industrial Radiography; Safety Precautions. R. King. Iron and Steel (London) 22, 633-5(1949) Dec.

The author describes briefly the biological effects of x-rays and γ rays and discusses some of the safety precautions to be taken in the use of these rays. The points covered are: the use of lead in lining rooms which house x-ray equipment, transport of radium, radon dangers, betatron problems, and electrical protection.

1123 Method of Measuring Thickness of Curved Sections and Apparatus Thereof. Herbert Friedman. U. S. Patent 2,462,088, Feb. 22, 1949.

A method of measuring thicknesses of curved sections and elements, using a radiation detector and source in such a manner, it is claimed, as to eliminate all dependence on direct thickness measurements is described. The source of the radiations and the detecting instrument are placed on the same side of the pipe; highly collimated radiations are passed through the curved part of the pipe and detected in relation to the amount of movement of the radiation beam and the pipe. An orthogonal relationship is maintained at all times between the radiation beam and the radius of the pipe. The intensity of the received radiation beam is a measure of the thickness of the pipe and the presence of any imperfections in the pipe.

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1124 Photoelectric Exposure Meter for Industrial Radiography. D. T. R. Dighton and R. H. Herz. J. Sci. Instruments 26, 404-7(1949) Dec.

An exposure meter for industrial radiography, using a multiplier photocell in conjunction with two different types of fluorescent screens, is described. The meter can be used for intensifying-screen and nonscreen exposures and covers a range of x-rays generated between 40 and 200 kvp.

1125 Seal. Allan M. Starr (to United States Atomic Energy Commission). U. S. Patent 2,442,622, June 1, 1948.

It is sometimes necessary to have a rod extending into a vacuum chamber through a seal which, although leakproof, permits rotational, translational, and rocking motion of the rod. In this invention this is accomplished by having the rod run through two sleeves, one sleeve being sealed into the chamber wall. A conical hole is bored in this latter sleeve to permit the rod to rock through a certain angle. The rod extends through the first sleeve into this hole, the abutting surfaces being so shaped as to permit a rocking motion of one sleeve with respect to the other. The sleeves are held together by an airtight metallic bellows which is connected with the vacuum chamber so that it may also be evacuated, and which is elastic enough to bend easily. Packing arrangements are used to insure the tightness of the seal.

1126 Vacuum Equipment and Techniques. A. Guthrie and R. K. Wakerling. New York, McGraw-Hill Book Company, Inc., 1949. 264p. NNES Div. I, Vol. 1. (See also NSA 2-368.)

This book is primarily a compilation of observations made in the course of developing high-vacuum equipment suitable for use in the electromagnetic separation plants. It is divided into five chapters with the following headings: Fundamental Considerations in Vacuum Practice, Elements of the Vacuum System, Vacuum Gauges, Vacuum Materials and Equipment, and, Leak-detection Instruments and Techniques. The first chapter is a study of those phases of kinetic theory which find application in modern vacuum practices. The others give details of the design and operation of vacuum apparatus. Except for the last chapter, each of the sections is written by men who have done development work related to the subject treated in the section.

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1127 Cemented Titanium Carbide. John C. Redmond and E. N. Smith. J. Metals 1, 987-93(1949) Dec.

Data and graphs are presented showing that cemented titanium carbide compositions prepared by powder metallurgy methods have transverse rupture strengths up to 175,000 psi or 75% greater than previously reported in the literature. Either cobalt, nickel, or iron may be used as an auxiliary metal. The two former appear very nearly equivalent in titanium carbide compositions. Iron is somewhat inferior. Compositions containing only titanium carbide and an auxiliary metal are considerably superior to the tungsten carbide compositions with respect to the character of the oxidation products. It has also been found that the addition of minor percentages of tantalum carbide or of columbium and tantalum carbide reduces the oxidation rate of the titanium carbide compositions to very small values at temperatures up to 2200°F. The general properties of cemented titanium carbide compositions are comparable with those of the cemented tungsten carbide compositions. When the strength, oxidation resistance, thermal expansion, and conductivity are considered, these compositions offer excellent possibilities as high temperature materials.

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1128 Melting Points in the System TiO_2-CaO-MgO-Al_2O_3. H. Sigurdson and S. S. Cole. J. Metals 1, 905-8 (1949) Dec.

Ternary and quarternary systems are presented diagrammatically showing the melting points of various titanate mixtures. A eutectic was established between $CaO{\cdot}TiO_2$ and $MgO{\cdot}2TiO_2$ at 40 mol% $CaO{\cdot}TiO_2$ and 60 mol% $MgO{\cdot}2TiO_2$. $Al_2O_3{\cdot}TiO_2$ additions up to 30 mol% did not adversely affect the melting temperatures of the mixtures, but a shift in the zone of fluidity toward the $CaO{\cdot}TiO_2$ part of the system was evident. 40 mol% $Al_2O_3{\cdot}TiO_2$ additions to the system caused a sharp decrease in the zone of fluid melts and a 50 mol% $Al_2O_3{\cdot}TiO_2$ addition gave only viscous melts.

1129 Age Determinations by Radiocarbon Content: Checks with Samples of Known Age. J. R. Arnold and W. F. Libby. Science 110, 678-80(1949) Dec. 23.

The radiocarbon method of age determination was applied to wood samples, which had been dated accurately by other methods. The measurement technique consisted of the combustion of about one ounce of wood, the collection of the carbon dioxide, its reduction to elementary carbon with hot magnesium metal, and the measurement of 8 g of this carbon spread uniformly over the 400 cm^2 surface of the sample cylinder in a screen wall counter. From the measured activity and the specific activity curve of C^{14} as a function of historical age, as calculated from the present day point and its known half-life (5,720 ± 47 years), the age of the wood samples, ranging from 1,100 to 4,750 years, was determined. Only one of the six average values and seven of the 17 individual runs, differ by more than one standard deviation unit from the predicted value, while statistically 32% may be expected to fall outside this limit. Thus the radiocarbon method of analysis agrees well with the conventional methods of age determination.

1130 Chemistry of Meteorites in the Light of Mendeleev's Table. P. N. Chirvinskiĭ. Doklady Akad. Nauk S.S.S.R. 65, 865-6(1949)(in Russian).

Elements found in meteorites are arranged in a periodic table showing relative abundances. Elements belonging to even groups of the table, and whose mass numbers are divisible by four, predominate. Expressing the relations in atomic percentages, we have in each group: I—0.75, II—14.12, III—1.23, IV—15.13, V—0.09, VI—53.65, VII—very little, VIII—14.71. The chief elements are O—52.33, Si—15.12, Fe—13.87, Mg—13.39 at. %; they form together 94.71 at. %.

Interesting correlations are: Si = 15.12, Mg + Ca + Na + K = 14.97, Fe + Ni + Co + Mn + Cr = 14.93. This should be confronted with the relationships found by the author for the sun's atmosphere: Si + Ti = 15.86, Fe + Ni + Co + Mn + Cr + V(Cu) = 15.44 at.%.

1131 The Deuterium Content of Free Hydrogen in the Earth's Atmosphere. Paul Harteck and Hans E. Suess. Naturwissenschaften 36, 218(1949)(Short communication, in German).

Since free hydrogen rapidly leaves the earth's gravitational field, and since it is continually being oxidized by the ozone in the upper atmosphere, it must constantly be replenished by organic decomposition on the earth and by the photodisintegration of atmospheric water vapor. It can be shown that the former process leads to a decrease in deuterium content, while the latter leads to an increase because of the high rate of escape of the lighter hydrogen. Atmospheric hydrogen was oxidized and the density of the condensed water was measured. This density was found to be higher than the density of ordinary water, the difference corresponding to a 25% enrichment of deuterium. It is thought that this enrichment is due to the escape of light hydrogen, described by Harteck and Jensen (Z. Naturforsch. 3a, 591(1948)).

1132 Measuring System for Borehole Radioactivity. Shelley Krasnow and Leon F. Curtis (to Shelley Krasnow). U. S. Patent 2,487,058, Nov. 8, 1949.

One object of this invention is to provide a means or apparatus by which one may measure radioactive properties and depth continuously from the top to the bottom of the borehole in which the detector is placed; both an immediate indication of the radioactivity at a particular spot and a permanent record are made. It is claimed that the apparatus is sensitive enough to distinguish between the radioactivity of the oil formation sought and the radioactivities of the surrounding strata, and an accurate picture is obtained of the formations encountered.

1133 Method and Apparatus for Determining the Inclination of Substrata. Gerhard Herzog (to The Texas Company, New York). U. S. Patent 2,464,930, Mar. 22, 1949.

A method is described for accurately measuring the angle of inclination of a formation from within a borehole, either cased or uncased, by taking readings from an instrument lowered or raised through the hole from a wire cable. The formations are bombarded with neutrons from a source in the bore hole; some of the neutrons are scattered in the formations and returned to the hole substantially in the horizontal plane to the source. The amounts of the returned neutrons reaching the hole are measured from sectors spaced substantially 120 deg. apart in a generally horizontal direction.

1134 Method and Apparatus for Logging Boreholes. Gerhard Herzog (to The Texas Company, New York). U. S. Patent 2,483,139, Sept. 27, 1949.

A method for the reception and detection of fast neutrons during the process of determining the nature and location of underground formation traversed by a borehole is presented. It is claimed that this method circumvents certain disadvantages, such as those encountered with the "neutron to γ-ray" log method; Geiger-Mueller counters, ionization chambers or proportional counters are employed with the new method. A low density, low pressure medium combined with a 1,000-v potential is used and only those discharges which are sufficiently large to indicate that they are caused by the returning neutrons are counted. The chamber is coated with a medium to emit α particles on bombardment with the returning neutrons.

1135 Method and Apparatus for Radioactivity Well Logging. Gerhard Herzog (to The Texas Company, New York). U. S. Patent 2,481,014, Sept. 6, 1949.

A method for determining the nature and location of various formations or strata traversed by a borehole is described; it consists of measuring the variations in the natural or induced radioactivity of the formations or strata. Greater speed and accuracy are claimed for this method which consists of providing a pair of high efficiency radiation detectors in a single housing and suspending the housing from a suitable cable through the logging hole. The detectors are vertically elongated and of different lengths, the shorter one being used alone to log thin strata formations at the rate of 1,000 ft/hr; when thicker formations are encountered both detectors are used simultaneously and the logging is carried on at the rate of 4,000-5,000 ft/hr.

1136 Method of Determining the Fluid Content of Well Cores. Morris Muskat and Norman D. Coggeshall (to Gulf Research and Development Company, Pittsburgh, Pa.). U. S. Patent 2,458,093, Jan. 4, 1949.

A method for determining the connate fluid content of a well core sample is described and consists of adding to the well drilling fluid a known concentration of artificially radioactive material soluble in the drilling fluid, then cutting and removing the core sample from the well and measuring the radioactivity of a known quantity of the sample to determine the amount of drilling fluid absorbed in the sample; the nature and quantity of the total fluids in the core sample are also determined. It is claimed that such a loss will reflect the variations in permeability and porosity of the strata.

1137 Radioactivity Well Logging Method. Gerhard Herzog (to The Texas Company, New York). U. S. Patent 2,458,596, Jan. 11, 1949.

A method of logging natural radioactivity by detecting γ radiation is described; it is claimed that by one passage of the logging instrument through the borehole two separate logs are obtained, one showing the general configuration of the strata and the other showing the breaks and interfaces between adjacent formations; the intensities of radiation from the strata are recorded essentially at full value. The pulses from the detector are simultaneously integrated in two circuits, one having a relatively long and the other a relatively short time constant. Means are provided for amplifying the pulses in the detector with a pre-amplifier and integrating and amplifying the pulses at the surface.

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1138 Reef Surveying with Radioactivity. R. A. Stothart. World Oil 130, 61-3(1950) Jan.
Automatic recordings of radioactive emanations are used for delineating buried reef structures which are regarded as potential sources of oil. The shales which overlie oil zones yield radioactive emanations indicating the limitations of the oil productive area. The usefulness of the method is shown by the fact that out of seven radioactive anomalies mapped and later drilled, four opened new fields and one had oil shows.

1139 Research on Creep of Alloys; Technical Progress Report to July 30, 1949. E. R. Parker and T. H. Hazlett. COO-1, Aug. 15, 1949. 12p.
An investigation to determine the effects of mechanical, thermal, and metallurgical factors on the creep resistance of alloys, with the specific purpose of obtaining more fundamental scientific data for the development of a better theory of creep has been undertaken. Purification of nickel, an extensometer design, temperature control, experimental creep test results, development of a strain recorder, and lattice constant determinations are reported.

1140 Research on Creep of Alloys; Technical Progress Report, July 30, 1949, to October 31, 1949. E. R. Parker and T. H. Hazlett. COO-3, Nov. 1949. 4p.
Work has continued on preparation of high purity nickel specimens; meanwhile a test program has been initiated with specimens of commercial pure nickel and nickel alloys.

1141 Attachment for Milling Machines. James Leigh Roush (to United States Atomic Energy Commission). U. S. Patent 2,462,997, Mar. 1, 1949.
An adaptor unit is described for attaching a power tool to the head of a milling machine or the like with two offset openings—one of a size to closely fit the quill of the machine and the other to hold the body of a power tool in offset relation to the quill and over the table of the milling machine. A downwardly extending rod (part of the adaptor unit) comprises a device which forms an outboard bearing for the cutter of the power tool. The bearing and the power tool are adjustable so that the material being worked on lies between them. The adaptor may be easily raised or lowered in relation to the work or the work is placed on an adjustable table whereby it may be adjusted relative to the spindle.

1142 Corrosion Resistance of Commercially Pure Titanium. G. E. Hutchinson and P. H. Permar. Corrosion 5, 319-25(1949) Oct.
Results are presented of some preliminary corrosion studies of pure titanium. These are based on the 120-day sea-water exposure test and several laboratory tests. Titanium possesses excellent resistance to sea-water corrosion and to atmospheric weathering. It is attacked by many common reagents but has very good resistance to chlorine water, chloride salts, and highly oxidizing reagents.

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1143 Laboratory Smelting of Titaniferous Ores. D. L. Armant and S. S. Cole. J. Metals 1, 909-13(1949) Dec.
The results obtained by smelting a series of mixtures of titaniferous ores in order to study the influence of composition upon the fluidity of the slag are presented in tabular form. The fluidity of these slags was not noticeably affected by the high Ti^{3+} content. Long holding in the furnace caused the slags to become viscous and even formed a sintered mass which was predominately Ti(OC). Fluid slags containing 65-69% TiO_2 were produced from ilmenites having 38-44% TiO_2. A high titanium slag can be produced in which the formation of appreciable amounts of Ti^{3+} may be avoided. The final slag with 62-69% TiO_2 requires 5-11% MgO and 9-13% CaO in order to have desired fluidity from MacIntyre and Baie St. Paul ilmenites. High titanium slags can be produced in an arc furnace with slag temperatures of 1450-1550°C which were identical in behavior and properties to the induction furnace slags.

1144 Method for Producing Metallic Beryllium and Alloys of Beryllium. Henry C. Kawecki (to Beryllium Corporation, Reading, Pa.). U. S. Patent 2,486,475, Nov. 1, 1949.
One object of this invention is to provide an economical and practical method for producing substantially pure beryllium and for producing beryllium-base alloys, light metal alloys and aluminum-beryllium master alloys. A method of reducing beryllium fluoride with the recovery of the pure metal is claimed. The method consists of adding beryllium fluoride to a molten bath of calcium fluoride at a temperature of 650-1100°C and then introducing metallic magnesium to the bath with stirring; finely divided beryllium metal is obtained in solution, since the magnesium replaces the beryllium in the fluoride compound. The metallic beryllium is recovered by dissolving in aluminum and then separating the molten aluminum-beryllium mixture from the reduction reaction products.

1145 Method of Welding Carbon to Molybdenum. Hubert P. Yockey and James M. Nuding (to United States Atomic Energy Commission). U. S. Patent 2,431,975, Dec. 2, 1947.
A method is described whereby the welding of two contacting materials, one of which is carbon and the other molybdenum, is accomplished by using an atomic hydrogen flame at atmospheric pressure. This is done while contacting the material with a molybdenum welding rod. The welding may be done by playing the atomic hydrogen flame upon the pieces to be joined and after the unmelted portion of the molybdenum rod is removed, the pieces are cooled by a supply of hydrogen until they solidify. The welding may be accomplished by using other methods of heating so long as a protective atmosphere is used.

1146 Method of Welding or Cutting Metal by Hydrogen-Fluorine Flame. Homer F. Priest and Aristid V.

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Grosse (to Director of the Office of Scientific Research and Development). U. S. Patent 2,421,649, June 3, 1947.

The use of the hydrogen-fluorine flame for welding or cutting metals, especially copper is discussed. The recommended ratio of the fluorine pressure to the hydrogen pressure is greater than 10 to 1. No external flux is required in welding copper since a copper fluoride coating is formed by the fluorine and metal during combustion.

1147 Petrology of High Titanium Slags. Charles H. Moore, Jr., and H. Sigurdson. J. Metals 1, 914-19 (1949) Dec.

The preparation of titaniferous slags and samples for metallographic examination are described. Several photomicrographs are shown with captions identifying the different mineral phases.

1148 Reactions of Zirconium, Titanium, Columbium, and Tantalum with the Gases, Oxygen, Nitrogen, and Hydrogen at Elevated Temperatures. Earl A. Gulbransen and Kenneth F. Andrew. J. Electrochem. Soc. 96, 364-76(1949) Dec. (See also NSA 3-1870; 3-2180.)

A systematic study is made of the kinetics of the reactions including a study of the time, temperature, and pressure variables. The reaction rates are studied by the vacuum microbalance method and the surface structures by the electron diffraction method. The data are correlated with fundamental diffusion and solution processes. Diffusion constants and energies of activation are calculated where possible and a comparison is made of the several reactions for the different metals.

1149 Vapor Pressure of Titanium. John M. Blocher, Jr., and I. E. Campbell. J. Am. Chem. Soc. 71, 4040-2 (1949) Dec.

The vapor pressure of solid titanium has been determined in the range 1,500-1,800°K by measuring the rates of evaporation of titanium wire using the Langmuir technique (Phys. Rev. 2, 329(1913)). The data fit the thermodynamic requirements quite well and yield heats of sublimation of 111,000 cal at 0°K and 111,700 at 298.2°K. The resulting equation for the vapor pressure of solid β-titanium, valid over the range 1,200-2,000°K is $\log p(\text{atm}) = 7.782 - (24{,}275/T) - 0.230 \times 10^{-3} T$. The data may be extrapolated to yield an equation for the vapor pressure of the liquid: $\log p\ (\text{atm}) = 6.255 - (22{,}110/T)$, leading to a normal boiling point of 3,535°K. The data agree over a limited range with the incomplete experimental results of Carpenter and Reavell (Nature 163, 527(1949)). Their equation for the rate of evaporation of titanium has been shown to be inconsistent with other available thermodynamic data.

1150 A Concentration of Uranium in Black Muds. Kaare Münster Strøm. Nature 162, 922(1948) Dec. 11 (Letter to the editor).

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In the Cambrian black shales of the Oslo area, there is a considerable concentration of uranium, analyses values ranging from 25 to 180 g/ton. The author has investigated black mud samples from several of the fjords along the Norwegian coast, with a view to determining to what extent this uranium is being concentrated in such sediments. Concentrations up to 60 g/ton were found, and echo soundings indicated that the thickness of the black mud layers ranges from less than a meter up to 20 m in some isolated places. Uranium content and other data are tabulated for ten samples.

1151 Inclusions with Low Uranium Content in Granites. René Coppens. Compt. rend. 229, 1221-2(1949) Dec. 5 (in French).

In a study of igneous rocks it has been found that these rocks sometimes contain radioactive inclusions with up to about 75% uranium or thorium content (Compt. rend. 229, 617 (1949)). The author has extended this work, examining granite samples from Brittany and Lignole. Photographic plates were placed on polished granite surfaces and exposed for periods up to 400 hr. Included radioactive crystals were found with cross sections ranging between several hundred and several thousand μ^2. Apparently these crystals contained about 4% uranium with little or no thorium. The exposed plates are sketched and the surface areas, activities, and uranium concentrations of the inclusions are tabulated. It is noted that the radioactive material is not distributed uniformly in the crystals.

1152 On the Helium Content of Minerals Containing Beryllium, Boron, and Lithium. V. G. Khlopin. Doklady Akad. Nauk S.S.S.R. 66, 893-4(1949)(in Russian).

The high helium content in minerals containing beryllium, which has been discovered by Strutt (Proc. Roy. Soc. 80, 572(1908)), has caused many speculations as to its origin. The latest in date is the hypothesis of Hahn (Naturwissenschaften 22, 744(1934)) postulating the disintegration $Be^9 \rightarrow 2He^4$ under the action of γ rays from radioactive elements present in the surrounding rock formation. The present author, in collaboration with Abidov (Doklady Akad. Nauk S.S.S.R. 32, No. 9(1941)), has discovered a similar helium enrichment in minerals containing boron and lithium. In this work, as well as in an earlier one (in Festschrift in Honor of Vernadsky, vol. 1, 401(1936)), the author showed the inadequacy of Hahn's explanation, and suggested, as a possible alternative, one of the following hypotheses: (1) certain minerals, at the time of their crystallization, selectively occlude helium from its solution in the magma, or (2) these minerals, at the time of their formation, capture short-lived radioactive elements. Recent investigations permit a final decision from among the explanations advanced. Meshcheryakov and Gerling, in 1946 (see Khlopin et al, Doklady Akad. Nauk. S.S.S.R. 61, No. 2 (1948)), and later Aldrich et al (Phys. Rev. 74, 1590(1948)) have shown the vanishingly small amount of He^3 in He^4 of radioactive origin in minerals; on the other hand, the last named authors observed that in helium obtained from beryls and the lithium-containing minerals spodumenes, the ratio He^3/He^4 is 0.5 ×

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10^{-7} to 12×10^{-7}, (i.e., the same as in natural gases). Consequently, the accumulation of He in these minerals is not a result of a radioactive decay, and its only possible origin is a selective occlusion from the magma.

1153 Pitchblende Occurrences of the Golfields Area, Saskatchewan. A. M. Christie and S. N. Kesten. Can. Mining Met. Bull. 42, 643-51(1949) Dec.
The pitchblende deposits are thoroughly described regarding their relation to the faulting, how they are found and with what minerals or elements they are generally associated, etc. Points to be considered for finding new deposits are outlined for prospectors.

1154 The Possible Existence of the 4n + 1 Radioactive Series in Chloritized Ytterby Mica. J. H. J. Poole, C. F. G. Delaney, and R. C. McCormick. Phys. Rev. 76, 1253-4(1949) Oct. 15 (Letter to the editor).
The X-type pleochroic halos discovered by Joly (Proc. Roy. Soc. 102A, 682(1923)) in chloritized ytterby mica of uncertain origin are discussed. Calculations based on diameter measurements seem to indicate that these halos are not due to the 4n + 1 or neptunium series. Further data are cited which suggest the aforementioned series, but again the evidence obtained disproved such a possibility. Enough of the radium isotopes were separated from 6 g of the mica to provide reasonably active sources. Data were taken to determine the presence of the 4n + 1 series and a negative result was obtained; however, it is noted that the method used would be effective only if the total activity of that series was comparable to that of the thorium and uranium series also present. Further investigations are in process to determine the nature of the surface distribution apart from the bulk distribution of the radioactivity in the mica.

1155 Radioactivity Measurements in the Kirkland Lake Area, Northern Ontario. Howard A. Slack. Trans. Am. Geophys. Union 30, 867-74(1949) Dec.
The measurement of the radioactivity of 136 rock samples within and around the Round Lake batholith near Kirkland Lake, Ontario, shows a regular increase in radioactivity from south to north. This is believed to be due to the northward plunge of the batholith and the migration of radioactive elements toward the top surface. This agrees with previous work by Keevil and Ingham (Am. J. Sci. 241, 345-365(1943)) on other batholiths. This evidence of the rise of radioactive elements suggests that the radioactivity of the crust as a whole may be much less than that determined from samples taken on its surface. Using values for the lower part of the batholith as representative of the granitic layer it is estimated that at Kirkland Lake 40% of the total heat flow from the interior of the Earth may be accounted for by the radioactivity of the rocks in the top 36 km of the crust. It is also assumed that erosion has removed the more highly radioactive material from the Earth's surface and deposited it as sedimentary, heat-producing shelves or dumps along the edges of the continents. These dumps may have determined the location and their heat may have assisted in the formation of marginal mountain ranges.

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1156 South African Source of Uranium. Anon. Chem. Age (London) 61, 791-2(1949) Dec. 10.
A terse report is given of progress regarding the extraction of uranium from low grade ores in the Rand Rock formations of South Africa. The extraction of minute quantities now presents formidable technical problems, but once these initial problems have been overcome, extraction can be undertaken by the already well-established mining industry. Preliminary investigations are already being conducted by research committees as to methods of exploitation of the Rand's resources.

1157 The Study of the Radioactivity of Rocks by the Photographic Method. E. E. Picciotto. Bull. soc. beige géol. paléontol. hydrol. 58, 75-89(1949) Aug. 16 (in French).
The use of photographic plates, and especially of the new Ilford and Kodak plates, in nuclear physics is briefly described. In particular, the application of these methods to the study of the radioactivity of rocks is discussed. In a series of studies made by the authors, the photographic plates were placed in close contact with a thin, highly polished sheet of the rock sample and then developed under specified conditions. This method was used to determine the concentration of U and Th in two radioactive rock samples, and the results are given. The samples were then reduced to powder form and the concentrations were again determined. Work on dissolved samples has not yet been completed. In conclusion, the relative merits of these different techniques are indicated.

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1158 The Cosmic Abundance of the Chemical Elements. Hans E. Suess. Experientia 5, 266-70(1949) July 15 (in German). (See also NSA 4-475.)
By multiplying by certain factors of correction Goldschmidt's or Unsöld's values for the relative abundance of the elements (Geochemische Verteilungsgesetze, IX. Oslo, Videnskapsakademien, 1938; Z. Astrophys. 24, 306(1948)), a general and coherent picture of the abundance of nuclei can be derived showing that simple rules hold for the abundance of the different types of nuclei. For a small number of elements a comparatively large correction of Goldschmidt's values is needed. Revised abundance values are tabled, including those for the rare gases. Two plots illustrate the general picture of nuclear abundance. Reference is made to the significance of this picture as a lead toward better theoretical understanding of the structure of the nuclei, and of the formation of the elements.

1159 Are Mesons Elementary Particles? E. Fermi and C. N. Yang. Phys. Rev. 76, 1739-43(1949) Dec. 15.
The hypothesis that π-mesons may be composite particles formed by the association of a nucleon with an anti-nucleon is discussed. In particular, it is assumed that the positive π-meson is composed of a proton and an anti-neutron, the negative π-meson consisting of an anti-proton and neutron. The neutral meson could be either a proton-anti-proton combination or a neutron-anti-neutron pair. Nucleons are

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assumed to repel each other strongly and to attract strongly anti-nucleons, all such forces having zero range, as distinct from conventional nuclear forces. From an extremely crude discussion of the model it appears that such a meson would have in most respects properties similar to those of the meson of the Yukawa theory.

1160 The Components of the Cosmic Radiation and Their Intensities in the Atmosphere. K. H. Höcker. Ann. Physik 6, 353-64(1949)(in German).

After discussing the spectrum of the primary radiation (protons) the author concludes from the great number of observed slow mesons that neutral particles are produced in explosive showers. Their number appears to be proportional to the square root of the energy of the proton initiating the shower. These neutral mesons then decay into charged mesons. In general they are supposed to have the properties demanded by the meson theory of nuclear forces. Electrons and photons are considered due to the decay of mesons, collision processes, and bremsstrahlung of mesons and protons. Finally, the intensities of the various components as function of altitude in the atmosphere are calculated and compared with experimental results.

1161 The Component of the Cosmic Radiation Which is Responsible for Star-production. K. H. Höcker and E. Schopper. Ann. Physik 6, 338-52(1949)(in German).

The experimental data on star production do not give direct evidence concerning the nature of the star-producing primaries. Therefore, the authors attempt to correlate data on star-production with those on the intensities of the various components of the cosmic radiation and the cross sections of the processes in which they can partake. The assumption that stars are due to the interaction between primary protons and the secondary mesons resulting from them leads to a rate of star production smaller than that observed. By admitting that neutrettos (light neutral mesons) also contribute to star production, a rate of production and also an altitude dependence more in accord with the facts can be obtained. The authors also conclude that the observed excess of neutral particles among those producing stars and the shift of the energy spectrum of the stars with altitude can be explained by this assumption.

1162 Cosmic Rays at a Great Depth. Y. Miyazaki. Phys. Rev. 76, 1733-4(1949) Dec. 1 (Letter to the editor).

Cosmic ray intensities and absorption were measured in Shimizu Tunnel at 3,000 m water equivalent. The equipment used was the same as those used earlier at 1,400 m water equivalent in the same tunnel (Nishina et al, Phys. Rev. 59, 401(1941)). With two different arrangements the vertical intensity of incident radiation was determined to be 0.0039, 0.0038 h^{-1} cm^{-2} $sterad^{-1}$, respectively. Absorption curves of cosmic rays in lead are given for the total radiation, for single particles, and for showers.

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1163 Counters for Cosmic Rays. C. G. Montgomery. Yale University Sloane Physics Laboratory Technical Report No. 2, Oct. 15, 1949. 81p. (NP-1226).

Since the pioneering experiment of Bothe and Kohlhorster (Z. Physik 56, 751(1929)) in 1929, Geiger-Mueller counters have played an important role in the measurement of nearly all phenomena connected with cosmic radiation. Although counters were first used many years before this for physical research (E. Rutherford and H. Geiger, Proc. Roy. Soc. (London) A81, 141(1908)), the principle of coincidence measurements and its application to the measurement of cosmic rays have since been intensively exploited by many workers. Electronic circuits were soon developed to select the time-coincident discharges of several counters and to record the resulting impulses. Since counters and the associated circuits are fundamentally simple, it is practical to combine many counters in one experiment. By the use of the technique of anticoincidences, even more complex experiments can be performed in which events of many kinds are simultaneously detected and recorded. An anticoincidence is an event in which one group of counters discharges without the occurrence of a discharge in another group of counters. The basic phenomena involved in a counter discharge and the circuits whereby the discharges are selected and recorded are described. The discussion of counters and their use for cosmic-ray investigations is divided into 5 parts. First the mechanism of the counter discharge itself is treated. Then the construction of cosmic-ray counters is described. The basic circuits used with counters form the subject of the third part. The application of counters and circuits are treated next, and a discussion is included of the efficiencies of counters and circuits and general considerations about the use of cosmic-ray telescopes and shower-detecting arrangements of counters. The last part is devoted to counters of special types (proportional, crystal, electron multipliers, scintillation). Extensive references included. (auth)

1164 The Decay and Capture of μ-Mesons in Photographic Emulsions. M. G. E. Cosyns, C. C. Dilworth, G. P. S. Occhialini, M. Schoenberg, and N. Page. Proc. Phys. Soc. (London) 62 A, 801-5(1949) Dec. 1.

Observations on the decay and capture of μ mesons in Kodak NT4 and Ilford G5 photographic emulsions are described. It is found, in agreement with other workers, that $63 \pm 4\%$ of all μ mesons stopping in the emulsion decay with the emission of a fast electron, a result which is shown to be in reasonable agreement with theoretical predictions. The emission of slow electrons is observed from $7.2 \pm 1.3\%$ of all slow mesons, and these are ascribed mainly to an Auger effect accompanying the capture of μ mesons.

1165 The Density Effect for Cosmic-Ray Mesons. W. L. Whittemore and J. C. Street. Phys. Rev. 76, 1786-91 (1949) Dec. 15.

This paper deals with a detailed study of individual pulses produced by fast cosmic-ray mesons in a specimen of silver chloride. A discussion is given of the pulse distributions obtained from the experiment, which was designed to show

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the increase with energy of the rate of ionization in the relativistic region and the correction to this increase due to the density effect. The measured values are compared with theoretical distributions which take fluctuation and density effect into account. It is concluded that the results agree well with the fluctuation theory developed by Symon (Fluctuations in Energy Loss by Charged Particles, dissertation, Harvard University, 1948) and the density effect corrections as given by Halpern and Hall (Phys. Rev. 73, 477(1948)).

1166 Interpretation of Underground Cosmic-Ray Data. K. Greisen. Phys. Rev. 76, 1718-19(1949) Dec. 1 (Letter to the editor).

Vertical cosmic ray intensity follows the depth as a power law with exponent ~ 1.9 down to a depth of about 300 m water equivalent, and with exponent ~ 2.9 at depths below 400 m, while extensive air showers have a power law energy spectrum with exponent ~ 1.8 continuing to energies 10^5 times greater than the energy which a meson must have to penetrate to the greatest depth at which they have been detected. Barnothy and Forro (Phys. Rev. 74, 1300(1948); Z. Physik 115, 140(1940)) have explained this anomaly by the hypothesis that the rays which penetrate to great depths are not mesons, but neutral decay products, which occasionally produce short range charged secondaries in or near the detecting apparatus. On the other hand Greisen (Phys. Rev. 73, 521(1948)) and Hayakawa (Phys. Rev. 75, 1958(1949)) suggested that μ mesons are the penetrating particles, but are themselves decay products of the π mesons produced high in the atmosphere. It is shown that either hypothesis can equally well explain the relation of vertical intensity vs. depth, as well as the zenith angle dependence of the underground intensity. A decision between the hypotheses could be made on the basis of accurate absorption curves, but the experimental material is too scarce to do this yet. Thus the question of the nature and origin of the underground rays is considered by the author to be still open.

1167 Investigation of Narrow Showers at 3250 m Altitude. A. Alikhanyan and A. Dadayan. Zhur. Ekspti. i Teoret. Fiz. 19, 78-85(1949)(in Russian).

New observations are described on narrow showers that have been discovered in cosmic radiation by Alikhanyan and Asatiani (J. Physics U.S.S.R. 9, 55(1945); Zhur. Ekspti. i Teoret. Fiz. 15, 225(1945)). The instrument used was a telescope of three counter groups recording (at least) quadruple coincidences of pulses in any three counters of the two lower groups and in one counter of the upper group. Spatial distribution, penetrating power, and density of particles in narrow showers were measured. It was found that at 3250 m altitude these particles form ~8% of all charged particles in cosmic rays. They do not seem to be generated in air by means of a cascade process. It is likely that their generation is due to some mechanism of multiplication of particles belonging to the hard component. They are formed, perhaps, as a result of a decay in air of heavy varitrons whose presence in the cosmic rays has been observed by the authors.

1168 The Meson Spectrum as a Function of Atmospheric Depth. C. M. Garelli. Nuovo cimento 6, 337-43 (1949) Sept. (in Italian).

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By introducing certain assumptions valid at high energy values, and using known experimental and theoretical data, a computation is made of the number g(x,W)dW of mesons, whose energy is comprised between W and W+dW, as a function of the atmospheric depth x.

1169 On the Low Energy Spectrum of Primary Cosmic Radiation and the Sun's Magnetic Dipole Moment. M. A. Pomerantz and M. S. Vallarta. Phys. Rev. 76, 1889-90(1949) Dec. 15 (Letter to the editor).

The vertical primary cosmic-ray intensity was measured at Swarthmore, Pennsylvania, and at Churchill, Manitoba, with and without lead absorber. The measurements were made with standard quadruple coincidence counter trains described in a previous article (Pomerantz, Phys. Rev. 75, 69(1949)), and plots of the counting rates against atmospheric pressure are given for one balloon flight at each location. The ratio of the vertical intensities with no lead absorber, extrapolated to the top of the atmosphere, was found to be 1.46. It may be shown that this figure is consistent with a differential energy spectrum in the range from 0.1 to 1.6 Bev for protons of the form $(K/E^{1.14})dE$. However, the diurnal variation was much smaller than that predicted by Dwight (Princeton Univ. Thesis (1949), unpublished), using the usual figure for the magnetic dipole moment of the sun. It is noted that this effect might be due to a variation in the magnetic moment of the sun.

1170 Apparatus for Magnetic Measurements. Wilson M. Powell (to United States Atomic Energy Commission). U. S. Patent 2,479,699, Aug. 23, 1949.

The primary purpose of this invention is to provide an improved and simplified apparatus for calibrating a magnetic flux meter. This is accomplished by passing through the search coil a current generated by a carefully controlled standard generating operation. This current is tapped off a coil as it falls through a certain distance on a vertical cylinder. The cylinder contains a permanent magnet at the top end and the coil is held at the top until it is released by some triggered mechanism. Many different taps are provided in order to supply different currents to the search coil. The apparatus may be calibrated originally against any standard and then used for any flux meter.

1171 Characteristics Required of X-ray Equipment with Ionization Chamber for Air-Density Measurements. Eva Winkler. Naval Ordnance Laboratory Memorandum 9883, Dec. 27, 1948. 25p. (NP-1019).

This memorandum discusses the characteristics of x-ray absorption equipment to be used for measuring the air-density distribution around models of projectiles or guided missiles in a supersonic wind tunnel. The possible accuracy of such density measurements is considered in its relation to the quality of the x-rays used, to the magnitude of the density of the air itself, and to the sensitivity of the x-ray intensity-measuring device used. Equipment using an x-ray tube with a Lindemann window (transmitting x-rays up to 3 A wavelength) and with an ionization chamber as the measuring device is found adequate for measuring air densities as low as 0.06 of the atmospheric density with an error of about 6%. Changes in apparatus are suggested to

achieve measurements of air densities as low as 0.01 of the atmospheric density with errors smaller than 5%. Such measurements require the use of 5 to 8 A radiation, necessitating the use of either a beryllium window x-ray tube or a demountable type x-ray tube with cellophane window or no window at all, and require a Geiger-Mueller counter as the measuring device. (auth)

1172 Current Integrating Network. William R. Baker (to United States Atomic Energy Commission). U. S. Patent 2,487,510, Nov. 8, 1949.

A current integrating circuit is described, that is an electronic circuit whose output is proportional to the quantity of the input. A schematic diagram is given of the circuit, which employs four gaseous discharge triodes, and its operation is discussed. It is claimed that the circuit described is characterized by great accuracy, sensitivity, simplicity, and compactness. Furthermore a method is given by which an electronic circuit can be made to charge and discharge a condenser at a rate which is a function of the current being integrated.

1173 Device for Measuring Thermal Conductivity. Charles B. Hood, Jr., Wesley Jones, and Herrick L. Johnston (to United States Atomic Energy Commission). U. S. Patent 2,475,138, July 5, 1949.

This invention is a device for the accurate measurement of the thermal conductivity of fluids and may, in some cases, also be used with solids. It consists of an inner sphere surrounded by a concentric spherical shell; the space between the sphere and the shell is filled with the fluid in question. The outer shell is immersed in a constant temperature bath and the inner sphere is heated by means of a resistance element embedded in the sphere. Thermocouples, distributed along the surface of the sphere, indicate the temperature of the sphere, and a wattmeter shows the power supplied to the sphere. From this information the thermal conductivity may be calculated.

1174 Direct-Current Amplifier. Barton L. Weller (to United States Atomic Energy Commission). U. S. Patent 2,455,718, Dec. 7, 1948.

An electronic amplifying circuit is described which is useful for amplifying direct currents or alternating currents, particularly those under 1,000 cps, of small magnitude, say $\sim 10^{-}$ amperes. The novel feature of the circuit is that two tubes are coupled in such a way that changes in the cathode current emission in the first tube will not be amplified or transmitted through the second tube and further stages of amplification. Thereby amplification of high fidelity is assured.

1175 Dynamic Condenser. Harry Palevsky and Robert K. Swank (to United States Atomic Energy Commission). U. S. Patent 2,483,981, Oct. 4, 1949.

An improved dynamic condenser is described which can be used to convert small direct voltages into alternating voltages and thus to measure small electric potentials and electrostatic charges. The resonant frequency of the condenser diaphragm is greater than 200 cycles per second, which largely eliminates the disturbing influence from any

power lines likely to be used. The electrodes are inclosed in a chamber filled with an inert gas, preferably argon, which damps the vibrations of the diaphragm and makes the conditions of resonance less critical. To minimize the contact potential between the diaphragm and the electrode, their surfaces are coated with gold, which is also relatively inert to the gas in the chamber. An illustration is given of a typical installation of the dynamic condenser in conjunction with an ionization chamber.

1176 Float Position Indicator. Donald S. Schover (to United States Atomic Energy Commission). U. S. Patent 2,452,156, Oct. 26, 1948.

A method is described by which a remote indication is provided of the position of a small object. The object under observation is placed in a glass ampule provided with a small metal tip of any suitable metal, either magnetic or nonmagnetic. The path of travel of this float is surrounded by an inductance coil, traversed by a high-frequency alternating circuit of relatively large amplitude. The displaceable metal body will absorb energy by eddy current losses, at a rate dependent on the flux intensity traversing the metal body. The coil is so constructed that the flux will vary with position so that the amount of energy loss will serve as an indication of the location of the float. An electronic circuit is described by means of which the energy loss can be measured.

1177 Furnace Control System. Harold W. Lindsay (to Director of the Office of Scientific Research and Development, Office for Emergency Management). U. S. Patent 2,410,384, Oct. 29, 1946.

In the heat treatment of metals it is necessary to raise the temperature of the sample to a predetermined value, to keep its temperature constant for some time, and then to cool it to a temperature slightly above the ambient temperature. This invention is designed to carry out such an operation automatically. The high and low temperatures may be set at will within a certain range. A system of three lights is provided to indicate that the sample is being heated, that it has reached its high temperature, or has been cooled to its low temperature. A thermocouple and standard temperature regulating unit control a set of relays which connect a heating unit to a power source.

1178 High Stability Voltage Regulator. William R. Baker (to United States Atomic Energy Commission). U. S. Patent 2,462,935, Mar. 1, 1949.

An electronic circuit is described for a voltage regulator of high stability. The operation of the circuit is based on the conventional voltage feedback principle.

1179 Impulse Type Power Supply. Elbert W. Marlowe and Howard A. Wilcox (to United States Atomic Energy Commission). U. S. Patent 2,470,895, May 24, 1949.

An electronic power supply circuit is described capable of delivering a substantial peak power, while its average power capacity may be small. The circuit supplies substantially rectangular voltage pulses which have regulated and adjust-

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able amplitude. It is readily adaptable for superposition of these rectangular pulses on a steady biasing voltage.

1180 Low Humidity Meter. Horace R. McCombie and Coleman D. Wilder (to United States Atomic Energy Commission). U. S. Patent 2,444,613, July 6, 1948.
This humidity meter determines the moisture content of a stream of gas by passing it through a packing containing a dehydrated agent with a high heat of hydration. For this purpose $Mg(ClO_4)_2$ has many advantages. The gas is forced into a box containing the packing by a constant speed pump, and the rate of flow of the gas may be determined with the aid of a manometer on the input tube. The temperature of the packing is measured by means of a thermocouple arrangement. For calibration purposes, air with a known dew point may be admitted into the meter and the corresponding thermocouple readings noted. Special provisions are made for such a calibration.

1181 Meter Protection Circuit. Curtis S. Ingram (to United States Atomic Energy Commission). U. S. Patent 2,451,953, Oct. 19, 1948.
An electronic circuit is described whose purpose it is to protect an electric meter from overload. When the current through the meter exceeds a safe value, a thyratron is made to operate a relay which short-circuits the meter. The meter then stays shorted out until the current has again reached a safe value.

1182 Nonlinear Coil Generators of Short Pulses. L. W. Hussey. Proc. I. R. E. 38, 40-4(1950) Jan.
Small permalloy coils and circuits have been developed which produce pulses well below a tenth of a microsecond in duration with repetition rates up to a few megacycles. The construction of these coils is described. Low-power circuits suitable for different types of drive and different frequency ranges are discussed.

1183 Regulator. Kenneth R. MacKenzie (to United States Atomic Energy Commission). U. S. Patent 2,468,678, Apr. 26, 1949.
This device is designed to regulate the current to an electromagnet coil so as to maintain a constant magnetic field. A resistance in series with the field coil feeds a voltage to a galvanometer, which, through a photocell arrangement, controls the d-c generator energizing the field coils. A new type of damping device is provided to avoid excessive overshooting in the galvanometer. This is accomplished by means of a secondary winding in the magnetic field. When the field changes rapidly a voltage is induced in this winding and fed back into the amplifier system with such a polarity as to counteract the effect of the primary change on the galvanometer. The regulating system is also so devised as to eliminate the delay caused by the various inductances and by the inertia of the galvanometer coil.

1184 Sedimentation Tube. John W. Williams and Edward M. Bevilacqua (to United States Atomic Energy Commission). U. S. Patent 2,436,083, Feb. 17, 1948.

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This invention is an improvement on sedimentation tubes of a type previously used. The suspension is contained in a vertical tube with small openings at the bottom and at the top (above the level of the liquid). These openings are connected by a capillary tube containing a measuring liquid. As the suspended particles settle out, the pressure at the bottom of the tube decreases and the level of the measuring liquid drops. Two changes have been incorporated into this device: first, the capillary tube is bent at the bottom in such a way as to prevent the particles of the suspension from diffusing into the measuring liquid and, second, the tube is closed at the top so as to avoid evaporation. It is also proposed that the capillary tube be provided with a stopcock at its upper end so as to avoid mixing of the measuring fluid with the suspending fluid.

1185 Vibration Eliminating Apparatus. Edward J. Egle, Jr. (to United States Atomic Energy Commission). U. S. Patent 2,474,042, June 21, 1949.
A method is described of inhibiting the vibration of mechanisms including a reciprocating element, such as pumps or compressors with a reciprocating piston. A particular example is given for a motor-compressor unit. A plate is mounted on top of the compressor by four posts, and a weight is suspended from it by four springs. The resonance frequence of this vibrational system is made equal to that of the compressor vibration by proper adjustment of the weight and the force constants of the springs, so that the vibration of the weight-and-spring system will compensate the vibration of the reciprocating piston of the compressor. Furthermore the plate from which the springs are suspended as well as the base plate on which the compressor is mounted, are attached by springs to firm supports, to take up the residual vibration.

1186 On the Abundance of the Isotopes of Zirconium. Heinrich Hintenberger. Z. Naturforsch. 4a, 76(1949) Apr. (Brief report, in German)
The author determined with a mass spectrograph of the Nier type the abundances of the zirconium isotopes as follows:

Mass	90	91	92	94	96
Abundance (%)	51.7	10.8	17.1	17.5	2.9

1187 Molecular Distillation Process and Apparatus for the Separation of Isotopes, etc. Aubrey Keith Brewer and Samuel Leo Madorsky (to United States Atomic Energy Commission). U. S. Patent 2,446,997, Aug. 17, 1948.
An improved method is described of separating isotopes by free evaporation. It is based on work by Brönsted and Hevesy (Phil. Mag. 43, 3(1922)), Mulliken and Harkins (J. Am. Chem. Soc. 44, 37(1922)) and Harkins and Madorsky (J. Am. Chem. Soc. 45, 591(1923)) whose apparatus consisted of a single operation cell. To reduce the enormous amount of labor and material involved in the separation of isotopes by a single such cell, it is proposed to use a multistage system employing 115 cells. A stream of substance to be distilled is moved by gravity from stage to stage in one direction, unidirectionally vaporizing and condensing ma-

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terial at the various stages. The condensed material is returned to the stream by gravity from stage to stage in the opposite direction, thereby effecting gravity refluxing of the molecular distillation.

1188 On the Separability of Isotopes in Solution. Proceedings of the German Bunsen-Society for Applied Physical Chemistry; Meeting, Oct. 7 - 10, 1948, in Stuttgart. H. Martin. Angew. Chem. 61, 297-305 (1949) July (in German).

This paper describes a separation principle which is fundamentally similar to the chemical separation procedure of Urey, but differs from it in the following respects: (1) The particle flow is produced by an electric field. (2) Particle flow and counterflow take place without spatial separation in a homogeneous one-phase system (solution). The method is applicable only if at least one partner in the exchange equilibrium considered is an ion (e.g.: $[OH_2D]^+ + H_2O \rightleftarrows [OH_3]^+ +$ HOD). In the direction of the field a fluid current is maintained, such that there is no net transfer of the mixture component to be separated. The author claims that the electrochemical separation method makes it possible to utilize very small deviations of the equilibrium constants from unity.

1189 The Separation Tube with High Pressure and a Radial Electric Field. E. W. Becker. Angew. Chem. 61, 306(1949) July (in German).

The separation tube of Clusius and Dickel was used at pressures up to 26 atm. It was found that the turbulence occurring at such high pressures increased the sharpness of separation by a factor of 20 while decreasing the separation yield by only 20-30%. Furthermore, by introducing a radial electric field it was possible to change the amount of turbulence and thus the separation efficiency.

1190 Adjustable Capillary Leak. Alfred O. C. Nier, Edward P. Ney, and Mark G. Inghram (to Director of the Office of Scientific Research and Development). U. S. Patent 2,422,921, June 24, 1947.

This invention relates to a device for controlling the flow of small quantities of fluids and, especially, of gases. It may be used to control the gas flowing into a mass spectrometer. The device consists of a piece of metal tubing flattened out so that the central opening is very thin. The tubing is then wound into two helices turning in opposite directions and an axle is inserted into the center of the coil. The tubing is fastened to this axle at the point where the helices meet and the size of the opening may be controlled by turning the axle and tightening or loosening the coils. A self-locking worm gear may be used to turn the shaft.

1191 The Characteristics of Electrical Discharges in Magnetic Fields. A. Guthrie and R. K. Wakerling. New York, McGraw-Hill Book Company, Inc., 1949. 376p. NNES Div. I, Vol. 5.

This volume describes most of the work done at the University of California Radiation Laboratory, under contract with the Manhattan Project, on the characteristics of electric discharges in magnetic fields, and particularly, of discharges

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in the vapors of uranium compounds. The first two sections describe the effect of the field on the arc plasma, and the methods used to explore the plasma. The following three chapters deal with the conditions necessary for stable arc operation. Chapters five, six and seven treat the ionization and dissociation of uranium tetrachloride and hexafluoride by electron impact. The remainder of the book consists of papers on the rate of ion production by an electron beam, a study of the arc plasma, different types of discharge cathodes, and the Philips ionization gauge discharge.

1192 Liquid Sampling for Analysis by Mass Spectrometer. R. A. Friedel, A. G. Sharkey, Jr., and C. R. Humbert. Anal. Chem. 21, 1572-3(1949) Dec.

A volume-measuring modification is described for the introduction and measurement of minute amounts of calibrating liquids in mass spectrometer analysis. The instrument used is the Consolidated mass spectrometer. In addition to the conventional gas-handling system of this instrument, the method requires only the usual mercury-sintered disk valve and a self-filling 0.001 ml micropipet. Two methods of use are described: an air-flow and a mercury-sealing method, with the air-flow method being somewhat more precise in most cases. Both methods give sufficiently good results, but their precision apparently decreases with vapor pressure.

1193 Mass Spectrometer System. Alfred O. C. Nier and Edward P. Ney (to United States Atomic Energy Commission). U. S. Patent 2,456,426, Dec. 14, 1948.

This device is designed to measure the ratio of two ion currents in a mass spectrometer. The ion currents fall on two separate collectors and each goes through a resistor to ground. The output of each resistor is fed to an amplifier, one of these amplifiers being provided with a negative feedback circuit. This amplifier is, therefore, a low impedance d-c voltage source, the output being proportional to the input and of opposite sign. This reversed output is then fed, through a potentiometer and a series resistance, to the input of the second amplifier. The potentiometer may be adjusted to give a zero output from the second amplifier and the ratio of the ion currents may be calculated from this null setting. One adjustment is therefore sufficient to determine the current ratio.

1194 Mass Spectrometers. Marcel Boivin. Chim anal 31, 5-9, 35-40, 61-64, 80-83(1949)(in French).

An outline of the development of the mass spectrometer is presented, with a description of the existing instruments and auxiliary apparatus. Special reference is made to applications of the mass spectrometer in analytical chemistry. 29 illustrations, 97 references.

1195 Mass Spectrometry. Harold W. Washburn and Clifford E. Berry (to the Consolidated Engineering Corporation, Pasadena, Calif.). U. S. Patent 2,486,452, Nov. 1, 1949. (See also NSA 4-238.)

This invention claims to provide improved means for protecting an ion beam from the effects of the static charge built up within the spectrometer; the calibration remains unchanged over long periods of time, so that accuracy is in-

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creased. An insulator is placed between each two collimating electrodes and is covered with an overlapping, conductive baffle, shielding the insulator from the ion beam; the baffle is conductively fastened to the second collimating electrode and is overlapped by a pair of baffles which connect conductively to the ends of the first collimating electrode.

1196 Factorization of a Secular Determinant by the Method of Polygons. Isaac Samuel. Compt. rend. 229, 1236-7(1949) Dec. 5 (in French).

The factoring of secular determinants by the method of polygons has been described in previous articles. This method has already been applied to symmetric determinants with equal diagonal elements, and the results in this case are briefly stated. A similar procedure is used to factor symmetric determinants with unequal diagonal elements, and the author indicates how this procedure may be applied to the determinants which arise in the calculation of molecular orbitals. It is also noted that the polygon method may be used, with slight modifications, for the factoring of any determinant.

1197 Integral Equations, Introduction to Theory and Applications. Georg Hamel. Berlin, Goettingen, Heidelberg, Springer-Verlag, 1949. 166p. (in German).

This book is based on lectures given by the author and is devoted to the theory as well as to the applications of integral equations. The first part deals with linear integral equations of the second kind with symmetric kernels. Physical applications are discussed, among them the boundary problem of potential theory in the plane, the vibrations of membranes and plates, the skin-effect, and Hilbert's formulation of elementary radiation theory. The second part contains a treatment of degenerate integral equations of the second kind according to the methods of Fredholm, Enskog, and Schmidt, as well as a discussion of the polar integral equation from the standpoint of Hilbert space. Examples are given of singular kernels from the theory of airplane wings. Finally, nonlinear integral equations are briefly discussed.

1198 The Determination of the Molecular Structure of Bromosilane by Microwave Measurements. A. H. Sharbaugh, J. K. Bragg, T. C. Madison, and V. G. Thomas. Phys. Rev. 76, 1419(1949) Nov. 1 (Letter to the editor).

The second and third rotational transitions of $Si^{28}H_3Br^{79}$, $Si^{28}H_3Br^{81}$ and bromosilane with Si^{29} and Si^{30} have been observed. Nuclear and molecular constants derived from the data are given. The hyperfine structure data is in good agreement with theoretical results, assuming the spin of bromine is 1/2. Structural parameters of the molecules were calculated and listed.

1199 A Precise Determination of the Slow Neutron Cross Section of the Free Proton and Slow Neutron Velocity Spectrometer Studies of O_2, N_2, A, H_2, H_2O, and Seven Hydrocarbons. Edward Melkonian. AECD-2761, Apr. 27, 1949, Decl. Dec. 19, 1949. 116p.

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The slow neutron velocity spectrometer has been used to study the interaction of slow neutrons with matter. The direct results obtained are sample neutron transmission as a function of neutron time of flight. These results are interpreted in terms of neutron cross section as a function of neutron energy. This investigation extends the range of the spectrometer from solid and liquid samples to samples in the gas phase. One solid and 2 liquid samples have been investigated for comparison. Results of previous investigations are summarized and compared with the present results. Experimental procedures and apparatus are briefly discussed. Appendix A on inscattering corrections covers the following cases: thin scatterer—one collision; long scatterer—one collision; thin scatterer—two collisions; long scatterer—two collisions. Appendix B covers the effect of molecular thermal motion. 40 references.

1200 Compressed Neutron Source. Herbert L. Anderson (to United States Atomic Energy Commission). U. S. Patent 2,440,999, May 4, 1948.

The invention comprises mixing a radioactive substance, such as radium either in elemental form or as a compound, with a neutron emitting material, such as beryllium metal, so that the rays emitted from the radioactive substance upon striking the beryllium metal will cause one or more neutrons to be emitted from the latter material. The mixture is subjected to considerable pressure to form a pellet of the desired shape and size which is tightly enclosed in a metallic container. The technique of the production of such sources is discussed as well as the ratio and amount of the ingredients necessary to obtain a desired neutron intensity.

1201 Determination of the Number of Thermal Neutrons by the Photographic Method. Ch. Haenny and O. Klement. Experientia 5, 281-2(1949) July 15 (Brief report, in French).

By means of photographic emulsions containing boron or lithium, the intensity of neutron flux was measured for slow and thermal neutrons. Measurement of the same flux with boron and lithium gave consistent results if proper experimental precautions were observed. The authors conclude from their data that the ratio of the lithium cross section to that of boron is 0.102.

1202 Multiple Scattering of Neutrons. II. Diffusion in a Plate of Finite Thickness. Otto Halpern and R. K. Luneburg. Phys. Rev. 76, 1811-19(1949) Dec. 15.

A rigorous analytical solution is given for the density and current distribution of neutrons which have been impinging with an arbitrary velocity upon a plate of finite thickness. The transport equation which is obeyed by the distribution function of the neutrons is set up, and then solved by means of a Laplace transformation. It turns out that to obtain the density at the boundary, one needs to know only the behavior of the Laplace transform of the density function, while knowledge of conditions inside the scatterer requires making another transformation from the Laplace transform back to the original density function. Asymptotic solutions also are given which are valid if the thickness of the plate is large compared with the mean free path of the neutrons inside the

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material, which will become rigorous for plates of infinite thickness, a case considered previously by the authors (Halpern et al, Phys. Rev. 53, 173(1938)).

1203 Note on the Distribution of Secondary Ionization Produced by a Neutron Flux Incident upon a Hydrogenous Substance. P. Capron, E. Crevècoeur, M. Faes, and G. Tavernier. Bull. acad. roy. Belg. cl. sci. 34, 906-29(1948)(in French).

Using thick Rh detectors, both with and without Cd screening, the flux distribution due to thermal and epithermal neutrons normally incident on the flat surfaces of paraffin and triplex blocks was studied. An empirical formula is derived which gives the thermal neutron density as a function of depth through the block, in terms of the diffusion length and total mean free path of the neutrons. The formula is used in calculating the secondary ionization produced by neutrons in hydrogeneous matter, through the absorption of the radiations from the reactions $H(n,\gamma)D$ and $N(n,p)C$. Various values are assumed for the diffusion length and mean free path of the neutrons. Tables and curves are given for the ionization dose at various depths in blocks of infinite thickness and also for the radiation received behind shields of different thicknesses.

1204 Perturbation Theory in Neutron Multiplication Problems. K. Fuchs. Proc. Phys. Soc. (London) 62 A, 791-9(1949) Dec. 1.

The perturbation theory for neutron diffusion problems in the one group theory is developed systematically by expansion in the system of orthogonal solutions integral equation of neutron diffusion. The multiplication of a neutron source inside a fissile system is discussed. The multiplication factor for a near critical system is derived as a function of the position of the source. Both isotropic and anisotropic sources are considered. Two practical applications of the theory developed are given. The theory is applied to two special problems: the effect of changes at the center of a spherical system, and the effect of a change in the neutron mean free path in a small region.

1205 Reproducibility of photo-neutron standards. L. F. Curtiss and A. Carson. Phys. Rev. 76, 1412-13 (1949) Nov. 15 (Letter to the editor).

Two nearly identical radium beryllium photo-neutron standards have been built following the suggestion of Gammertsfelder and Goldhaber (Phys. Rev. 69, 369(1946)) by enclosing compressed radium in a beryllium sphere. One may be borrowed for comparison measurements. Although the radium capsules were made as nearly identical as possible, it was found that the amount of radium in each was not the same after completion. The ratio of radium contents for standard I to that of standard II was found to be $I_\gamma/II_\gamma = 0.9897$ with std. dev. = 0.052% by measurement of the external γ radiation. The ratio of neutron intensities was $I_N/II_N = 0.9871$. The neutron intensity may be corrected for differences in the masses of radium and beryllium in the sources, with good results. Radium beryllium fluoride sources, prepared by other authors (Bretscher et al, Proc. Roy. Soc. (London) 196A, 436(1949)) are also discussed.

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1206 The Effect of Nuclear Shells upon the Pattern of the Atomic Species. William D. Harkins. Phys. Rev. 76, 1538-40(1949) Nov. 15 (Letter to the editor).

Isotope charts, showing the abundance of the various isotopes, are reproduced. Several effects of proton and neutron magic numbers are indicated. It is noted that the neutron magic numbers are much more important than the proton numbers. Those elements in which the 50- or 82-neutron shells are completed seem to be specially stable and abundant and, in addition, mark discontinuities in certain properties of the series of stable elements. The proton shells and the 20- and 126-neutron shells seem to be less important in all respects. However, it is noted that the abundance of tin is due to the completion of the 50-proton shell.

1207 Hyperfine Structure and Nuclear Moment of Pb^{207}. A. L. Schawlow, J. N. P. Hume, and M. F. Crawford. Phys. Rev. 76, 1876(1949) Dec. 15 (Letter to the editor).

The recent radiofrequency induction measurement (Proctor, Phys. Rev. 76, 684(1949)) of the nuclear magnetic moment of Pb^{207} makes possible an additional confirmation of the effect of finite nuclear radius on the electron-nuclear magnetic interaction constant (Rosenthal and Breit, Phys. Rev. 41, 459(1932); Crawford and Schawlow, Ibid 76, 1310(1949)). The theory is tested by comparing the nuclear moment calculated from the spectroscopically determined interaction constant of a single 5-level electron with the directly measured moment. The value obtained by nuclear induction measurements is 18% higher than the spectroscopic value. It has been shown for Tl that the correction due to the finite volume of the nucleus increases the spectroscopic value by about 15%. This same effect would give rise to an 18% correction in the case of Pb^{207}.

1208 Isotopic Report, Tabular Survey of the Properties of Atomic Nuclei as Known at the End of 1948. Josef Mattauch and Arnold Flammersfeld. Tubingen, Verlag der Zeitschrift für Naturforschung, 1949. 244p.

This report tabulates all nuclear information available as of the end of 1948. It contains details on about 300 stable and 700 unstable nuclei, 2,000 different nuclear reactions, and a bibliography of more than 2,000 papers. The Plutonium Project Report and the Table of Isotopes by Seaborg and Perlman (Revs. Modern Phys. 20, 585(1948)) are incorporated. The text is written both in German and in English.

1209 A New Isotope Rule, Relating Vibrational Intensities. Bryce L. Crawford, Jr. University of Minnesota. Jan. 1, 1949. 7p. (NP-1093).

It is shown that the infrared intensities of two isotopic molecules are related by the sum rule, rigorous in the harmonic approximation: $\Sigma_a A'_a/(w'_a)^2 = \Sigma_b A''_b/(w''_b)^2$, where A'_a is the integrated band intensity over the ath fundamental, w'_a the ath fundamental frequency, the superscripts (') and ('') distinguish the two isotopic molecules and the summation is over all modes of the same symmetry species of the point group

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to which both isotopic molecules belong. The relation for Raman intensities, I'_a, is: $\Sigma_a I'_a/w'_a = \Sigma_b I''_b/w''_b$, the summations being made in the same way.

1210 Nuclear and Molecular Information from the Microwave Spectrum of FCl. D. A. Gilbert, A. Roberts, and P. A. Griswold. Phys. Rev. 76, 1723(1949) Dec. 1 (Letter to the editor).

The rotational transitions for $J = 0 \rightarrow 1$ in FCl^{35} and FCl^{37} were observed near 30,000 mc for both the ground vibrational and the first excited vibrational state, by means of a Stark absorption cell resistant to fluorine corrosion. The hyperfine structure due to the electric quadrupole moment of the chlorine nuclei splits the $J = 1$ levels so that the observed lines were triplets. The hyperfine structure spacings do not agree with the theoretically predicted pattern for nuclear quadrupole splitting, even including second order corrections. The values of the quadrupole coupling energy were found to be $eqQ^{35} = -145.99 \pm 0.26$ mc and $eqQ^{37} = -114.92 \pm 0.26$ mc. The ratio eqQ^{35}/eqQ^{37} being only in fair agreement with the ratio moments obtained by Davis and Zabel (Phys. Rev. 74, 1211A(1948)). The mass ratio $Cl^{35}/Cl^{37} = 0.9459775 \pm 0.000004$ which agrees with the value 0.9459801 ± 0.000005 obtained by Townes et al (Phys. Rev. 73, 1334 (1948)) from the microwave spectrum of ICl, but differs from the best mass spectroscopic value, 0.9459445 ± 0.000007 (Okuda et al, Phys. Rev. 58, 578(1940)).

1211 On the Isotope Shift Effect in the Spectrum of Ba I. H. Kopfermann and G. Wessel. Nachr. Ges. Wiss. Göttingen (No. 2) 53-5(1948)(in German).

Both before and after absorption by a beam of Ba atoms, the hyperfine structure of the line at 5536A was photometered. A main peak due to Ba^{138} was observed on a plot of the product of the absorption coefficient and thickness of the absorbing layer as a function of the frequency of the absorption line; a tail was observed on the higher frequency side which was analyzed into smaller peaks which have been attributed to the isotopes 137, 136, 135, and 134. The corrected value of the separation between peaks for isotopes differing by two units is given as 0.016 ± 0.004 cm^{-1}.

1212 On a Shell Model for Atomic Nuclei. Wolfgang Ehrenberg. Z. Naturforsch. 4a, 70-4(1949) Apr. (in German).

A shell model of atomic nuclei is developed which is claimed to be in accord with the observed stability maxima in the sequence of atomic numbers, and with the stability limits of the isotope series. Stability maxima are determined by the following criteria: maximum of relative abundance, minimum of capture cross section for thermal neutrons, maximum of lifetime within a radioactive decay series, minimum of lifetime in a β decay series in the immediately preceding element, and the β activity of the immediately preceding element. A detailed table is given of shells, free of, filled, and partially filled with protons, as suggested by the author for elements ranging in atomic number from 2 to 96.

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1213 On the Magnetic Moments of Sn^{115}, Cd^{111}, Cd^{113}, Pt^{195}, and Hg^{199}. W. G. Proctor and F. C. Yu. Phys. Rev. 76, 1728-9(1949) Dec. 1 (Letter to the editor). (See also NSA 2-1229.)

By means of a nuclear induction spectrometer described previously (Phys. Rev. 75, 522(1949)) the following magnetic moments were measured:

Nucleus	Magnetic moment in nuclear magnetons	Diamagnetic correction in percent
Sn^{115}	-0.9132 ± 0.0003	0.50
Cd^{111}	-0.5922 ± 0.0002	0.47
Cd^{113}	-0.6194 ± 0.0002	0.47
Pt^{195}	$+0.6004 \pm 0.0002$	0.93
Hg^{199}	$+0.4993 \pm 0.0002$	0.96

The corrections due to the diamagnetic field of the atomic electrons given in the third column, were not included in the computation of the magnetic moments from the data. They were determined by linear interpolation from the values for specific atoms given by Lamb (Phys. Rev. 60, 817(1941)) using Hartree fields and must be applied so as to increase the magnitudes of the magnetic moments.

1214 The Transient States of Nuclear Reactors. I. C. Salvetti. Nuovo cimento 6, 303-26(1949) Sept. (In Italian).

In this first part of a study on nuclear-fission piles, the latter's behavior during transient states is investigated, the effect due to delayed neutrons not being considered. The neutron-density equation is integrated for the following two cases: in the "static" approximation, in which the finite slowing-down time of neutrons is neglected; and in the "nonstatic" approximation, where this time is taken into consideration. It is found that, at least for the ordinary type of nuclear reactors, the slowing-down time does not influence to a notable degree the transient behavior of the installation. A determination is made of the periods of the various harmonics into which the neutron density can be expanded, and of their dependence on the dimensions of the reactor. The effect due to delayed neutrons will be examined in the second part of this work.

1215 U^{235} Fission Yields in the Rare Earth Region. M. G. Inghram, R. J. Hayden, and D. C. Hess, Jr. AECD-2759, May 1949, Decl. Dec. 19, 1949. 11p.

The U^{235} fission yield curve for uranium fuel rods, from mass number 143 to 160, has been measured by use of mass spectrometric techniques. Eight percentage yields are assumed in this region, and on the basis of measurements of the neodymium, samarium, europium, and gadolinium fission isotopes, nine other yields are obtained. The resulting yield curve is smooth. Based on the same assumptions which give the smooth yield curve the following cross sections and half-lives are obtained. Cross Sections: Sm^{149}, 47,000 barns; Sm^{151}, 7200 barns; Gd^{155}, 41,000 barns; Gd^{157}, 59,500 barns. Half-lives: 61^{147}, 2.26 yr; Sm^{151}, 122 yr. (auth)

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1216 Relative Yield Functions for π-Mesons from Carbon. Stanley B. Jones and R. Stephen White. UCRL-543, Dec. 7, 1949. 11p.
This paper describes determinations of the relative yield curves for π-mesons generated by α-particle and proton beams striking carbon targets. The mesons counted had energies of 2-10 Mev and angles to the beam direction up to about 45 deg. (auth)

1217 The Division of Nuclear Charge in Fission. D. C. Brunton. Phys. Rev. 76, 1798-1802(1949) Dec. 15.
Recent measurements of fission fragment energies emphasize the difficulty of reconciling the variations in kinetic energy with current hypotheses of charge distribution. The assumption of a close relationship between charge and kinetic energy is used here to derive a new distribution. The energy associated with each possible charge division between a pair of fragments of given masses is computed and compared with the measured energy as a function of frequency for the same mass pair. In this way a charge-frequency curve is derived on the assumption that most of the variation in fragment kinetic energy is associated with variation in the division of primary charge. The marked disagreement between the charge distribution arrived at here and previous hypotheses is discussed, and the relation between charge distribution and stable nucleon shells is considered.

1218 High Energy Photo-Disintegration of the Deuteron. J. F. Marshall and E. Guth. Phys. Rev. 76, 1880-1 (1949) Dec. 15 (Letter to the editor).
Computations of total cross sections and angular distributions for the photo-disintegration process have been carried out for square-well radii of 1.8 and 2.8×10^{-13} cm in the energy range 20-100 Mev, and for zero radius in the range 20-300 Mev on the following assumptions. (a) The electromagnetic interaction is represented by $E \cdot r$ (rather than $A \cdot v$) and $\mu \cdot H$ for electric and magnetic dipole transitions, respectively, and by equivalent expressions for higher poles. (b) The wells for the triplet and single states are assumed to have the same radius ($r_0 = r_t = r_s$). This assumption is probably a fair approximation for energies up to 100 Mev. (c) A 50-50 mixture of ordinary and Majorana forces is assumed for both triplet and singlet states. The total cross sections for these two radii, as well as for the radius zero are plotted against the photon energy, and the angular distributions are plotted for 50-50 and 100-0 mixtures of ordinary and Majorana forces. The data for the 100-0 mixture was obtained from previous work by Rose and Goertzel (Phys. Rev. 72, 749(1947)).

1219 Influence of the Nature of the Target on the Chemical States of Radio-Nitrogen Produced in the Reaction $C^{12}(d,n)N^{13}$. Pierre Süe. Compt. rend. 229, 878-80(1949) Nov. 2 (in French).
Carbon, in the form of graphite and in the compound Li_2CO_3, was bombarded with deuterons in a cyclotron. In the graphite target cyanide was produced, as was expected. However, significant amounts of ammonia were found in the carbonate target, in addition to the expected nitrites and nitrates. The relative amounts of the compounds produced have been tabulated, the results being quite different for the two targets. Possible explanations for these differences are outlined.

1220 (n,γ) Recoil Effects in Potassium Chromate and Dichromate. J. H. Green and A. G. Maddock. Nature 164, 788-9(1949) Nov. 5 (Letter to the editor).
Crystals of potassium dichromate, sealed in a silica ampoule, were bombarded by slow neutrons in the Harwell pile. A small but definite Szilard-Chalmers separation was observed, the yield (12%) depending little on the pH of the solution in which the dichromate is dissolved. These results are in conflict with those found by Muxart et al (Nature 159, 538(1947)).

1221 On a Model of $_4Be^9$. V. de Sabata. Nuovo cimento 6, 368-73(1949) Sept. (in Italian).
The cross section for photodisintegration of Be^9 is calculated, this nucleus being considered as a two-body system, in which the so-called "optical" neutron is bound to the rest of the nucleus by means of two adjoining rectangular potential wells. The deeper of the two wells, which has a narrower range, corresponds to the bulk of the nuclear forces, while the other well represents a weak "tail," according to a concept that has already been used (Bohm and Richman, Phys. Rev. 71, 567(1947)). This model accounts for the minimum in the cross section curve obtained experimentally, which is placed near the photoelectric threshold. The calculated values of the ranges and depths of the two potential wells are, respectively, 23×10^{-13}cm, 30×10^{-13}cm, and 147.11 Mev, 2.049 Mev.

1222 On the Possibility of Producing Unlimited Chains of Nuclear Reactions in a Medium Containing Uranium. John A. Wheeler. Compt. rend. 229, 909-14(1949) Nov. 7 (in French).
The action of a finite mass, containing only the elements U, H, and O, is analyzed. A fast neutron in the mass may, with certain probabilities, be absorbed before or after reaching thermal energies, or diffuse out of the mass. A thermal neutron may, with a certain probability, cause a fission. A criterion is developed for determining, in terms of these probabilities, whether an explosive reaction will take place. It is concluded that such a reaction could occur if the normal isotopic content of the substances were changed, or if the U and H were arranged properly in an inhomogeneous mass.

1223 Photo-Disintegration of the Deuteron at Intermediate Energies. J. F. Marshall and E. Guth. Phys. Rev. 76, 1879-80(1949) Dec. 15 (Letter to the editor).
In the photo-disintegration process, all but a small fraction of the γ-ray energy appears as relative energy of neutron and proton, while in N-P scattering half of the incident neutron energy appears as kinetic energy of the center of mass of the N-P system. Consequently, for energies well above the threshold, photo-disintegration experiments should yield as much information about the N-P interaction as N-P scat-

tering experiments performed at twice the energy. Therefore, it is noted, studies of the photo-disintegration process are of considerable theoretical importance. An expression is given for the cross section of this process, neglecting tensor forces, and the correction due to the presence of tensor forces is estimated. An expression is also given for the angular distribution of the disintegration product. These expressions are compared with the results of recent experiments by Fuller (Phys. Rev. 76, 576(1949)) which, however, were not accurate enough to permit any definite conclusions. A more complete treatment including the influence of the shape of the interaction potential and a more detailed analysis of the effect of tensor forces is in preparation.

1224 The Reaction $B^{10}(n,\alpha)Li^7$ and the Range-Energy Relation for Particles with Energies Below 2 Mev. Henriette Faraggi. Compt. rend. 229, 1223-5(1949) Dec. 5 (in French).

The transmutation of boron has been studied with the aid of a technique of partial effacement (Compt. rend. 227, 527 (1948)). An Ilford plate, loaded with boron, was exposed to neutrons and then kept for 18 min in an atmosphere saturated with hydrogen peroxide. The partial effacement of the latent image prevented the development of the first grains of the α track and made it possible to measure accurately the ranges of the two fragments. The energies of the particles may be calculated, and ranges and energies are tabulated. Unlike previous, less accurate figures, these results fit very well into the range-energy curve of Livingstone and Bethe (Revs. Modern Phys. 9, 245(1937)).

1225 The State of Oxidation of S^{35} Formed by Neutron Irradiation of Potassium Chloride. W. S. Koski. J. Am. Chem. Soc. 71, 4042-5(1949) Dec.

The state of oxidation of S^{35} formed by neutron irradiation of potassium chloride depends on the pre-irradiation treatment of the crystals. If the crystals were carefully outgassed by heating and pumping the radioactive sulfur appeared in part either as sulfur or more probably as sulfide ion. If no precaution was taken to remove air from the crystals all of the S^{35} appeared in the hexavalent state. In all cases tested there was always some activity present as hexavalent sulfur and in the most favorable situation as little as 15% of the total sulfur activity was present in the highest oxidation state. It is concluded that atmospheric oxygen which is occluded in the crystal is responsible for the hexavalent state of the radio sulfur.

1226 General Recommendations for Design of Small Cyclotrons. Louis Wouters. UCRL-476, Oct. 21, 1949. 15p.

The steps necessary in the design and fabrication of small cyclotrons are developed in some detail. Magnet design and supply, tank design, the oscillator, and early operational details are discussed and schematic drawings are appended. (auth)

1227 A Focussing Device for the External 350-Mev Proton Beam of the 184-inch Cyclotron at Berkeley.

W. K. H. Panofsky and W. R. Baker. UCRL-499, Nov. 15, 1949. 12p.

The external beam of the 184-in. synchro-cyclotron is produced by a pulsed electrostatic deflector displacing the cyclotron orbits to enter a magnetic shield which channels the beam to the outside of the magnetic field. The beam thus produced covers an area of approximately 8 sq in. at the bombarding position (about 46 ft from the center of the cyclotron). Since the total beam attained thus far is only of the order of 10^{-9} amp, the resultant beam density is insufficient for many experiments or at least leads to long runtimes. Since in most experiments beam density rather than total current is the determining factor, a focussing device is considered of advantage. Both horizontal and vertical focussing is possible by means of a wedge-shaped deflecting magnet. The use of such a device, although practical in principle, was rejected here since it involved re-location of the target facilities and also since the physical size of a focussing magnet at this energy and aperture is very considerable. It was, therefore, decided to study an "in-line" focussing device, i.e., a device focussing without deflection. The device chosen consists essentially of a current carrying cylindrical conductor whose axis is parallel to the beam and which is transparent to the passage to the beam. If the current density is uniform, the magnetic field will increase linearly with the radius and a linear restoring force on the beam will result. A current carrying conductor transparent to the proton beam was realized physically in the form of an arc inside a cylindrical glass tube 3 in. in diameter and 48 in. in length. The operation of this focussing device is discussed.

1228 Radiation Laboratory Magnet Regulators, Service and Operation. C. H. Harris. UCRL-520, Nov. 14, 1949. 29p.

The present use of electro-magnetic fields in the cyclotron magnets, focussing magnets, beam turning magnets, and analyzing magnets have at times required a stability in the magnetic field of 1 part in 3,000 for an hour or more. Normally the magnetic hysteresis of the iron may be ignored, and assuming no magnetic saturation of the iron, the magnet current must be held to 1 part in 3,000 or 0.03%. If partial magnetic saturation of the iron is present, a larger variation of magnet current may be allowed and the field still held to the desired accuracy.

The four main causes of variation in a closed loop current regulation system are: (1) Variation in load resistance due to heating. The effect of load resistance change is reduced if ample loop gain is provided in the regulating system. (2) A change in the reference voltage. This will cause an error proportional to the voltage change, irrespective of the loop gain. (3) Transient line voltage changes which reflect in the generator voltage or in the regulator output. Here again, the stabilizing effect is a function of the loop gain. (4) Hunting of the regulator. Hunting is usually due to phase shifts associated with the time lags in the control system.

Operating characteristics of the various regulating systems in use at the Radiation Laboratory are discussed.

1229 Accelerator Magnet Structure. W. F. Westendorp (to General Electric Company, Schenectady, New York). U. S. Patent 2,491,345, Dec. 13, 1949.

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The nonuniform path length of the flux lines of a betatron magnet usually decreases the efficiency of betatron operation. The eddy currents produced by the long flux lines near the outer edge of the field produce a phase lag near the rim of the magnet. This difficulty may be overcome by the use of secondary windings with load resistors so designed as to cause a compensating phase lag in the central portions of the field. Such an arrangement of secondary windings is described in this patent.

1230 Experiments on the 1/10 and 1/4 Scale Model of the Harwell Cyclotron. J. M. Dickson and M. Snowden. Atomic Energy Research Establishment Report AERE-G/R-400 Sept. 1949. 17p.

Part I of the report deals with the design of the rotating condenser used to modulate the frequency of the Harwell 110-in. cyclotron. Condensers were tested on the 1/10 scale R. F. model of the cyclotron dee circuit. The method of determining the stray capacities of these condensers is described. In Part II experiments using an accurate 1/4 scale model of the dee circuit are described. The circuit was made to self oscillate by coupling it to a CV288 triode valve and the oscillatory frequencies compared with the resonant frequencies. Modifications were introduced to decrease the voltage on the rotating condenser and to increase the maximum frequency of the circuit. The Q of the circuit was measured under various conditions. The resonant frequency range could be varied by the addition of condensers on the dee or on the rotating condenser.

1231 Method and Apparatus for Control of Beam Energy. Charles P. Baker (to United States Atomic Energy Commission). U. S. Patent 2,485,470, Oct. 18, 1949.

An apparatus for the measurement and the control of the energy of beams of charged particles is described. It consists essentially of a foil (of a thickness t) that can be rotated so as to form various angles 90 deg. $-\alpha$ with the axis of the beam; the length of the path of a particle across the foil is thus equal to $t\sec\alpha$; (the instrument is referred to as a "secant foil"). The advantage of such a device is to permit the use of only one foil, instead of many, when various thicknesses of matter must be placed in the path of a beam. The instrument is used for the measurement of ranges and energies of accelerated particles, for the control of a radiation used for a specific purpose, for the elimination of undesired components, etc.

1232 The Microwave Linear Electron Accelerator. G. R. Newbery. Brit. J. Radiology 22, 473-86(1949) Aug. (See also NSA 2-240.)

The present interest in linear accelerators for nuclear physics and medical use, which has arisen from the development of microwave valves and waveguide techniques during the war, is reviewed, and the various types of microwave linear accelerators are briefly described. The operation of traveling wave, standing wave, and multi-cavity accelerators is then described in detail. The theoretical and practical limitations of the performance of each type of accelerator at a design frequency of 3000 Mc/sec (10-cm wavelength) are discussed. The design of linear accelerators at this frequency suitable for medical use is discussed, and tentative layouts of 5-Mev and 10-Mev machines are given.

1233 On the Theory of Radial Oscillation of Electrons in a Betatron. Helmut Jahn and Hans Kopfermann. Ann. Physik 6, 305-20(1949)(in German).

Approximations are derived for the equations of motion of electrons in the electromagnetic field of a betatron, which describe the oscillation of the electrons radially, with a finite amplitude, about their instantaneous circular path. In particular the damping of the oscillation amplitude is considered. A comparison is made with experimental results obtained from a betatron with an output of 6 Mev.

1234 Spectral Analysis of 10-Mev Betatron Radiation by Nuclear Emulsion. P. K. S. Wang and M. Weiner. Phys. Rev. 76, 1724-5(1949) Dec. 1 (Letter to the editor).

The spectrum of the 10-Mev betatron at the Naval Ordnance Laboratory was measured by recording and measuring the proton tracks from the photo-disintegration of deuterium absorbed into nuclear emulsion. Of 500 tracks on plates soaked in D_2O, 312 were selected which had a slope of $\leq 45°$ in the wet emulsion. The experimental number of protons as a function of energy (range) was compared with the theoretical distribution based on the x-ray spectral intensity as calculated by Schiff (Phys. Rev. 74, 1710(1948)) with an assumed maximum energy of 11.0 Mev. At the low energy end the theoretical exceeds the experimental spectrum, which is at least partially due to the difficulty of finding all the short tracks, while at the high energy end the experimental exceeds the theoretical spectrum.

1235 Two Metre Linear Accelerator. L. B. Mullett. Atomic Energy Research Establishment Report No. No. AERE-EL/R-385, Aug. 1949. 23p.

The report describes performance data for the 2-meter Linear Accelerator at Malvern. The energy has been accurately determined, and in particular the behavior of the machine at large beam currents has been investigated. Data has also been obtained concerning the focussing field requirements and the direction and spread of the beam. (auth)

1236 Thermal Conductivity of Gas Mixtures. Alexander L. Lindsay and LeRoy A. Bromley. UCRL-461, Sept. 1949. 18p.

An equation is developed for the thermal conductivity of gaseous mixtures, which requires only a knowledge of the pure component conductivities, heat capacity or viscosity, boiling points, and molecular weights. The equation reproduces 85 mixture conductivities from the literature with an average deviation of 1.9%. 13 references. (auth)

1237 A Measurement of the Velocity of Light. R. A. Houstoun. Nature 164, 1004(1949) Dec. 10 (Letter to the editor).

In a letter in Nature 142, 833(1938), the author described a new method of measuring the velocity of light in which

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Fizeau's toothed wheel was replaced by a piezo-quartz crystal. Using this method, the speed of light was measured as 299,775 km/sec, with the same accuracy as that of other recent measurements. However, it seems likely that, by making some simple changes in the equipment, the accuracy could be improved by a factor of ten.

1238 Proceedings of the German Physical Society in the British Zone. Meeting Held at Bonn on Sept. 21-25, 1949. Physik. Blätter 5, 511-24(1949)(in German).

Among the papers presented at this meeting were the following: The Mass of He^4, H. Ewald; Measurement of the Heat of Reaction of the Reaction $N^{14}(n,p)C^{14}$, P. Meyer; Enrichment of C^{13} According to an Exchange Method, E. W. Becker, Scholz and W. Vogel; A Critical Survey of Nuclear Models, W. Ehrenberg; Energy Loss of Fast Electrons Passing through Be, C, H_2O, Fe, and Pb, W. Paul and H. Reich; Measurements on Penetrating Showers, O. Haxel; Multipole Radiation as an Eigenvalue Problem, W. Franz; On the Electrodynamics of Rotating Bodies, T. Schlomka; Plasma in Static Fields, A Schlüter; Measurement of Vapor Pressures below 10^{-8} atm, A. Herlet.

1239 Hylides and Nuclides. Modesto Bargalló. Ciencia 9, 261-3(1948) (Published July 1, 1949)(in Spanish).

The advantages are discussed of the term "hylide," suggested by the author, over the word "nuclide" coined by Kohman (Am. J. Phys. 15, 356(1947)). Both terms denote a substance composed of identical atoms, in contradistinction to the term "isotope" which designates a substance as a member of a group characterized by a certain atomic number. The word "hylide," derived from a Greek noun meaning "matter," is more readily adaptable to generic and comprehensive definitions than "nuclide" which has an unnecessary etymological connection with "nucleus."

1240 On a Nomenclature Question. F. Demichelis. Nuovo Cimento 6, 397(1949) Sept. (Letter to the editor, in Italian).

This is a discussion of the advisability of the introduction of new terms, such as "nuclide" (Kohman, Am. J. Phys. 15, 356(1947)) and "monotope" (Perard and Terrien, Comp. rend. 228, 964(1949)). The author suggests a nomenclature comprising "mononuclides" (substances whose nuclei are of the same kind), "polynuclides" (mixtures of mononuclides in any proportions), "polytopic elements" (substances found in nature, or in products of chemical reactions, as consisting of mononuclides in constant proportions), "monotopic elements," and "isotopes" (mononuclides belonging to a group characterized by the same atomic number).

1241 Proceedings of the American Physical Society. Meeting Held on Nov. 5, 1949, at Cleveland. Phys. Rev. 76, 1890-1(1949) Dec. 15.

Among the papers presented at the meeting of the Ohio section of the Americal Physical Society were the following: Monochromatic Electron Groups in Long-Life Manganese, W. S. Emmerich, L. H. Ballweg, and J. D. Kurbatov; Radiations Emitted by Long-Life Species of Nickel, D. G. Thomas and J. D. Kurbatov.

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1242 Alpha Hand Monitor MK I—Description and Operating Instructions. F. S. Goulding. Atomic Energy Research Establishment Report No. AERE-A/R-156, nd. 18p.

A completely automatic instrument has been developed for monitoring of α contamination on the hands of workers handling such materials as uranium ore. The total time required for a check of the hands is 30 sec. The instrument includes two air-proportional type counters (NRC Report CrTec-320) and an indicating meter for each hand. Complete operating and maintenance instructions are given along with operating characteristics and circuit details.

1243 Dependence of the Brightness of Scintillations in Zinc Sulfide on the Crystal Size. T. V. Timofeeva. Doklady Akad. Nauk S. S. S. R. 66, 1079-80(1949) (in Russian).

In a recently published work (Izvest. Akad. Nauk. S. S. S. R., Ser. Fiz. 13, No. 1-2 (1949)), the author has shown that the brightness of scintillations, produced by α rays in copper-activated ZnS crystals, grows with the crystal's volume up to a certain value of the latter, beyond which the brightness remains constant. Two causes can produce this effect: (1) a certain minimum crystal volume is required in order to absorb the whole energy of an α particle, and (2) a certain quantity of the activator is required to spread the excitation received. In the latter case, the effect must depend on the concentration of the activator, viz. there should exist an inverse relationship between the optimal volume and the activator concentration. This was tested in the experiments described in the present paper. The Cu concentration in samples used varied from 3×10^{-6} to 2×10^{-3} g/1 g ZnS. Scintillations in single crystals were measured under a microscope, the physiological aspects of the method employed having been critically weighed. The results showed the independence of the value of the optimal crystal volume from the concentration of the activating substance: the optimal size of the ZnS crystal was about 5μ in all cases. This value is close to the mean range of α particles in ZnS, viz. 5.8μ.

1244 Differential Ion Chamber. James W. Broxon (to United States Atomic Energy Commission). U. S. Patent 2,440,167, Apr. 20, 1948.

This invention is a device which may be operated so as to measure either the combined effects or the separate effects of slow neutrons and other penetrating radiation. The device consists, essentially, of three concentric cylinders, the spaces between them forming two chambers of equal volume. The walls of the outer chamber are coated with some substance which emits alphas when bombarded with slow neutrons. The central cylinder is connected to the casing of the instrument through a galvanometer, and the other two cylinders may be maintained either at the same or opposite potentials. When they are at the same potential, the reading on the galvanometer is a measure of the total intensity of the penetrating radiation. When, on the other hand, the cylinders have opposite potentials, no reading is produced in the absence of slow neutron radiation since the ionizing effects of other radiation is the same in both chambers. The meter reading is then proportional to the intensity of slow neutron radiation. The desired voltage arrangement may be chosen by throwing a switch.

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1245 Differential Twin Chamber Neutron Meter. Herbert M. Parker (to United States Atomic Energy Commission). U. S. Patent 2,437,476, Mar. 9, 1948.

This invention is designed to measure the intensity of neutron radiation in the presence of radiation of other types and especially of γ rays. It also provides a means for detecting directional effects which may be eliminated in the final reading. This is accomplished by means of two ionization chambers, one filled with a gas like argon which is not ionized by neutron bombardment, the other filled with a gas rich in hydrogen, which is ionized by neutrons through the action of recoiling protons. The pressures in the two chambers are so adjusted that the ionization produced in each by equal γ activities is equal. In order to measure neutron activity, the chamber walls are maintained at opposite potentials. The central conductors are connected to each other and a common lead goes to an electroscope. The chambers may be interchanged to detect directional effects.

1246 The Effect of Magnetic Fields on the Output of the 1P21 Photomultiplier Tube. J. D. Graves. Naval Radiological Defense Laboratory Report No. AD-164 (P), Sept. 23, 1949. 15p. (See also NSA 3-457.)

The amplification of photomultiplier tubes is affected by application of axial magnetic fields. The effect of such fields on pulse counting and total current measuring scintillation detectors has been determined quantitatively. (auth).

1247 Efficiency of Luminescence of Zinc Sulfide Produced by α and γ Rays. T. V. Timofeeva. Doklady Akad. Nauk S. S. S. R. 67, 259-62(1949)(in Russian). (See also NSA 4-290.)

In a previous work (Izvest. Akad. Nauk S. S. S. R., Ser. Fiz, 13, 135(1949)), the author has found a value of a few per cent for the efficiency of the luminescence of ZnS produced by α rays, the efficiency being the ratio between the energy of luminescence and the exciting energy. Values given by other authors are of the same order of magnitude (4-12%), with the exception of that found by Riehl (Wolf and Riehl, Ann. Phys., (Ser. 5), 11, 103(1931)) which is 80%. The present author repeated her measurements, using many ZnS screens, by the method described in the previous paper. The efficiencies varied between 0.5 and 2.6%. Similar discrepancies show the determinations of the efficiency of luminescence produced by γ rays. Born and Riehl (Doklady Akad. Nauk S. S. S. R. 59, No. 7(1948)) give a 71% efficiency, while the author finds 0.4 to 1.0%. Another experimental study described here is that of the dependence of the efficiency on the concentration of the activator (copper) when various excitations are used (α, γ, $\beta + \gamma$, and ultraviolet rays). The extinction effect due to the excess of the activator is similar in all cases, the corresponding curves having the same shape; however, there is a difference in the absolute values of the activator concentration at which the effect begins.

1248 Fast Neutron Meter. Carl C. Gamertsfelder, Jr. (to United States Atomic Energy Commission). U. S. patent 2,481,506, Sept. 13, 1949.

This patent describes an apparatus for accurately measuring the intensity of neutron radiations in the presence of γ radiations. The apparatus consists of two chambers arranged concentrically with respect to each other and around a rod electrode; both chambers are equally responsive to γ radiations but the outer chamber is also responsive to neutrons; collecting fields of opposite charge are placed on the chambers. The net magnitude of the current generated in the two units is equal to the response to the neutron bombardment alone. Other details of the construction are presented; the chambers are described as being gas-tight, metal and electrically insulated.

1249 Fast Neutron Meter. Ernest O. Wollan. U. S. Patent 2,481,964, Sept. 13, 1949.

An apparatus for the exclusive measurement of fast neutrons is described which is claimed to be of relatively simple structure and easy operation. It consists of two ionization chambers connected by a tube, each chamber containing two electrodes; the electrodes from the two chambers are connected, one pair forming the output terminal and the other pair the input terminal. The first chamber is filled with a gas of atomic weight not greater than 4; the second chamber contains gas of atomic weight greater than 4. Both chambers have a similar response to γ rays, but one chamber has enough gaseous hydrocarbon added to permit proton recoil measurements to be made. The net response obtained is concluded to be the neutron response.

1250 Geiger Counter Improvement. Allen F. Reid (to United States Atomic Energy Commission). U. S. Patent 2,442,314, May 25, 1948.

The alkyl mono-halides of two to six carbon atoms in their vapor phase have been found to be excellent quenching gases for Geiger counters. The alkyl halide used may have any of the possible isomeric forms. The halogen atom of the halide may be chlorine, bromine, iodine, or fluorine, but only one halogen atom should be present in the molecule. The halide may be an ethyl, propyl, butyl, amyl, or hexyl halide. Among the alkyl monohalides of 2 to 6 carbon atoms, there are individuals or groups of individuals which are particularly desirable with respect to a certain characteristic. Thus the monohalides of higher chain length give better plateaus so that if an especially good plateau is desired, one of the amyl halides of hexyl halides should be used. As the atomic weight of the halogen atom decreases, the stability of the molecule increases and hence its lifetime. The gas pressure in the counter is adjusted with reference to the voltage used. For the mono-alkyl halides of 2 to 6 carbon atoms a useful range of pressures was found to be 9 to 25 mm Hg.

1251 Geiger-Mueller Counter. Jan Bleeksma (to Philips Laboratories, Inc., Irvington-on-the-Hudson, N. Y.). U. S. Patent 2,479,201, Aug. 16, 1949.

A Geiger counter is described, and it is claimed that this device is easily assembled and adjusted, is free from field distortion and has both long life and electrical stability. The device consists of a central anode portion and a tubular envelope surrounding the anode and comprising the cathode portion. The tubular envelope is in the form of a cylindrical sleeve with two glass, cup-shaped tapered ends. One of the ends supports a radiation permeable window, while the other end holds a metallic member which is fused to it and which

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passes into the device and through the central anode. The chamber is filled with a mixture of an ionizing gas and a quenching medium.

1252 Ion Mobilities in Geiger-Mueller Counters. H. Den Hartog and F. A. Muller. Physica 15, 789-800(1949) Sept.

Formulas and measuring instruments are described for a detailed study of the deionization current in a self-quenching Geiger-Mueller counter. More specifically, the recovery characteristic, the dead time, and the break in the current caused by the interception of the ions are analyzed. It is shown that all phenomena concerned can be accurately accounted for on the basis of a uniform ion mobility. Ion mobility in alcohol is found to be 2.6 cm/sec per V/cm, in argon, 7.1 cm/sec per V/cm, both at 100 mm Hg pressure. Earlier quantitative data given by Van Gemert and the authors (Physica 9, 658(1942)) are superseded by the present more accurate ones.

1253 Ionization Chamber. Harold D. Roop. U.S. Patent 2,458,099, Jan. 4, 1949.

A method for increasing the sensitivity of ionization chambers and a description of a multiple-element, compact ionization chamber which employs a saturated, easily dischargeable system without high voltages are presented. Phosphors which emit ultraviolet light on excitation by x-rays are used; they generate supplementary radiations and decrease the voltage resistance, allowing lower intensity radiations to be detected. The apparatus consists of a chamber containing two sets of electrodes, each electrode comprising a number of tubular electrodes placed in parallel; the electrodes of one set bisect those of the other set and at least some of the individual electrodes are coated with the type of phosphor described above.

1254 Ionization Chamber. Barton L. Weller (to United States Atomic Energy Commission). U.S. Patent 2,436,084, Feb. 17, 1948.

Standard ionization chamber design has been modified with the intention of improving the reliability of the measurements and providing greater safeguards against the high voltages used in the instrument. This is accomplished by a system of guard rings and shields which prevent the appearance of high potentials across insulators and shield the different electrodes and leads from each other.

1255 Ionization Chamber Circuit. Francis R. Shonka (to United States Atomic Energy Commission). U.S. Patent 2,479,271, Aug. 16, 1949.

An ionization chamber circuit and arrangement are described which eliminate the harmful effects of the grid-current of the vacuum tube connected with the control electrode of the chamber. In addition to the source of radioactivity which is being measured, a supplemental radioactive source is introduced which, by means of the circuit described, removes from the control electrode of the direct current amplifier the charge which it accumulates by reason of the collection

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of charge within the electronic tube. This procedure is especially useful in connection with an ionization chamber used for measurement of integrated radioactivity, for which the harmful grid-current effect would otherwise cause serious difficulty when the chamber is run over a period of several hours.

1256 The Luminescence Characteristics of Tin Activated Zinc Sulphide Phosphors. G. F. J. Garlick and D. E. Mason. Proc. Phys. Soc. (London) 62 A, 817-22 (1949) Dec. 1.

It has been found that the inclusion of stannous compounds in relatively large concentrations in the preparation of zinc sulfide phosphors results in an intense red luminescence when excitation is by ultra-violet light of long wavelength (3650-4000 A). Such characteristics as the luminescence spectra, excitation spectra, phosphorescence and thermoluminescence, and the variation of luminescence with temperature have been studied. The hexagonal crystal form of zinc sulfide is essential to the production of efficient phosphors with tin as the activating impurity.

1257 Measurement of Penetrative Radiation. Gerhard Herzog (to The Texas Company, New York). U.S. patent 2,486,946, Nov. 1, 1949.

A method is claimed for the simple and auditory determination of variations in penetrative radiations; the volume of the detector device varies with the amount of radiation received. The output of the detector is converted to a direct current voltage, the size of which is proportional to the counting rate. The voltage is applied to an amplifier tube, and an alternating current voltage is impressed simultaneously on the tube grid; the detector output is thus converted to sound. A method for determining the thickness of a wall by detecting reflected γ radiations is also described.

1258 Measurements of Radioactivity. Leon F. Curtiss. Washington, D.C., National Bureau of Standards Circular 476 (n.d.) 84p.

The chapters deal with such topics as detection and measurement of radioactive radiations, measurement of ionization currents, radioactive substances, equipment for producing artificially radioactive isotopes, radioactive standards and units, radioactivity in geology, and health protection.

1259 Method and Means for Detecting Ionization. James S. Allen and Bruno B. Rossi (to United States Atomic Energy Commission). U.S. Patent 2,485,469, Oct. 18, 1949.

The use of a mixture of monatomic and polyatomic gases to fill ionization chambers and counters is discussed. It is shown that the proportions of the mixture should be determined so as to maximize the drift velocity of electrons in the mixture which is assumed to be proportional to L/v, where L is the mean free path and v the velocity of thermal agitation. Two gases, mixtures of which have been found useful for this purpose, are argon and carbon dioxide. Percentages of carbon dioxide as low as 0.5% and as high as

20% have been found satisfactory, the particular percentage chosen being a function of the applied voltages between the electrodes in the detecting device, the gas pressure, and the kind of event detected. In a chamber in which continuous circulation and purification of the gas is provided, it is preferable to use at least 2% of carbon dioxide because losses occur on account of the purification.

1260 Neutron Detector. Emilio G. Segre and Clyde E. Wiegand (to United States Atomic Energy Commission). U. S. Patent 2,491,220, Dec. 13, 1949.

An improved neutron detector of extreme sensitivity to detect the presence of small numbers of neutrons is described; all γ-ray effects on the meter are eliminated. The instrument consists of a long metal tube, open at one end, and a second superimposed tube (enclosed within a material designed to slow fast neutrons) having elongated lateral walls, an enclosing end wall and an open end. A gas impermeable barrier is provided between the open end of the second tube and the opposite exterior wall of the first tube, and a gas medium (boron tri-fluoride at increased pressure) with a low capture cross section with respect to fast neutrons and a high cross section with respect to thermal energy neutrons is sealed between the two tubes; an electrical potential is maintained between the two tubes. The slowed neutrons cause α-particle emission in the medium, subsequent ionization and potential discharge in the medium and ultimate detection.

1261 Neutron Detector and Method of Making Same. P. G. Koontz (to United States Atomic Energy Commission). U. S. Patent 2,491,320, Dec. 13, 1949.

The standard method of measuring neutron activity by means of a neutron sensitive counter is often impossible to use because of the bulk of the measuring apparatus. This difficulty may be overcome by exposing a sheet of neutron sensitive material at the point where the activity is to be measured. This sheet may then be wrapped around the tube of a Geiger counter. The measurements should be carried out under standardized conditions, and the sensitive materials may, if desired, be surrounded by a substance which slows down fast neutrons. The sheets should be of uniform size, and strong enough to bend around the counter tube. Such sheets may be made by compressing the sensitive material, in powdered form, in a specially designed mold. Procedures for making such sheets are described in detail in the patent.

1262 On the New Technique of Scintillation Counters. I. Mario Ageno, Mario Chiozzotto, and Ruggero Querzoli. Atti accad. naz. Lincei 6, 453-7(1949) (in Italian).

A similar article by the authors was published in Nuovo cimento 4, 217-227(1949). This article appeared in Nuclear Science Abstracts as abstract No. 3-1992.

1263 On the New Technique of Scintillation Counters. II. M. Ageno, M. Chiozzotto, and R. Querzoli. (Atti Accad. naz. Lincei 6, 626-31(1949)(in Italian).

In this second note on scintillation counters (Atti accad. naz. Lincei 6, 453(1949)), preliminary experiments are described on the possible use of liquids and solutions, instead of crystals, for scintillation counters. The majority of substances examined showed a measurable photoeffect under the impact of γ quanta. Solutions show stronger effects than pure solvents. However, in the preliminary observations described here the effect is rather weak; (the substances examined were xylene, water, amyl acetate, ethyl alcohol, and solutions of naphthalene in xylene). The measurements dealt with the dependence of the fluorescent effect on the width of the liquid medium traversed by γ rays, and on the concentration of the solution. This latter dependence, which shows, for increasing concentrations, a saturation state following an initial rise, differs from Perrin's law of exponential decrease, valid for the ultraviolet fluorescence of solutions.

1264 Photomultipliers for Scintillation Counting. George A. Morton. R C A Rev. 10, 525-53(1949) Dec.

The performance of scintillation counters is analyzed in terms of their essential component, the photo-multiplier tube. It is shown that to obtain optimum performance, the photo-multiplier must fulfill certain requirements of photocathode geometry, electron efficiency, and gain. Various commercially available multipliers are discussed with respect to these requirements. The photo-electric efficiency, multiplication statistics, resolving time and dark current are considered in some detail. An outline is given of basic multiplier power supplies and output circuits useful for scintillation counters.

1265 Polarized Fluorescence of Solutions of Anthracene and of Several of Its Derivatives. L. A. Spektorov. Doklady Akad. Nauk S. S. S. R. 65, 485-8(1949)(in Russian).

Measurements of the polarization of fluorescence of polycyclic aromatic hydrocarbons and their derivatives were made by a photoelectric method in which the modulation of the light studied was obtained by a system consisting of a rotating biquartz and a fixed analyzer. The magnitude measured was the rotational depolarization, from which the limiting value of the polarization characteristic of the substance was obtained. Such values are given in a table for a number of anthracene and pyrene derivatives. The significance of the results obtained for the theory of viscosity and of molecular oscillators is discussed.

1266 Radiation Detector. William R. Baker (to United States Atomic Energy Commission). U. S. Patent 2,474,773, June 28, 1949.

An electronic circuit is described which is used to amplify the pulses obtained in an ionization chamber. In particular, a cathode follower type pre-amplifier tube is provided, which has a very high effective input impedance and a relatively low time constant. These are characteristics which have been found particularly useful in connection with ionization chamber work.

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1267 Radiation Exposure Meter. Ernest O. Wollan, Louis A. Pardue, and Norman Goldstein (to United States Atomic Energy Commission). U.S. Patent 2,483,991, Oct. 4, 1949.

This radiation exposure meter consists of photographic film sensitive to γ- and x-rays contained in a metal box provided with an opening to admit radiation. A filter is placed over the film, the properties of the filter being such that the film will be blackened equally by equal numbers of roentgens of radiation of various frequencies. Two or more sheets of film may be used, of different sensitivities, so as to increase the range of exposures which may be accurately measured.

1268 Shallow Plane Proportional Counter. Robert W. Thompson (to United States Atomic Energy Commission). U.S. Patent 2,485,516, Oct. 18, 1949.

An improved proportional counter is described in which a pair of parallel plate cathodes of high transparency are used in conjunction with an anode of novel design. Compared to conventional cylindrical proportional counters the effective counting area is thus substantially increased while uniformity of respones is retained. The maximum deviation from the average response, as determined empirically, is the order of 6%, varying cyclically with respect to the average value. It is furthermore shown that by using a plurality of planiform electrode assemblies a counter can be constructed which is particularly adapted for the determination of the characteristics of ionizing particles by multiple coincidence and anti-coincidence methods. The counting rate of the proportional counters is given as a function of discriminator bias, as determined experimentally by directing a collimated beam of α particles normal to the plane of the electrodes midway between, and immediately adjacent to, anode wires. Finally the amplification is given as a function of counter voltage for a gas inside the counter at pressures 4 cm Hg and 30 cm Hg, respectively, the gas consisting of 97% argon and 3% carbon dioxide.

1269 A Sodium Photon Counter. I. L. Rolkh. Zhur. Eksptl. i Teoret. Fiz. 19, 269-70(1949)(Letter to the editor, in Russian).

While almost all writers on photon counters worked with the ultraviolet light, the author made an attempt to construct a counter recording photons of the visible part of the spectrum. A sodium photocathode of desired purity was obtained by electrolysis through the glass wall of the tube filled with hydrogen at 20 mm Hg. The sensitivity improved after a glow discharge was applied. Although the stability is not satisfactory, the first results obtained are promising; the number of dark pulses is small; there is a fairly wide plateau at ~ 1,000 v; a 25-w electric bulb, distant 1 m from a metal box containing the counter, produced numerous pulses in the latter.

1270 Tests of Self-Regenerating Fillings for Geiger Counters. S. A. Korff and A. D. Krumbein. Phys. Rev. 76, 1412(1949) Nov. 1 (Letter to the editor).

It is reported that counters filled with ammonia have been operated at high counting rates for long periods without deteriorations. Synthesis of ammonia in the counter by the Haber process counteracts the effects of decomposition. The background counting rate increases in long runs but returns to normal after a rest. Counters with aquadag cathodes recovered fastest. An increase in photo-sensitivity, which remained even after long rest periods, was also noted.

1271 Use of Bremsstrahlung in Making Rapid Assays of Millicurie Amounts of Phosphorus-32. Tikvah Alper and Lorene du Preez. Nature 164, 1001 (1949) Dec. 10 (Letter to the editor).

It is noted that the conventional method of β-ray measurement, for checking the activity of a pure β-emitter in therapeutic amounts, has several disadvantages which are avoided in a new type of procedure. A high-pressure ionization chamber may be used to measure the bremsstrahlung from the radioactive sample, 2 mc of P^{32} being easily detectable by such means. The bremsstrahlung intensity may then be compared with that produced by a standard radium source, and it is found that the radium equivalent of an ampoule of P^{32} may be measured with an error that lies within the permitted range.

1272 Action as a Space Coordinate. I. Yu B. Rumer. Zhur. Eksptl. i Teoret. Fiz. 19, 86-94(1949)(in Russian).

It is shown that the movement of a point in gravitational and electromagnetic fields, considered as a problem of relativistic mechanics (both in its classical and quantum aspects), is equivalent to a problem of optics (both geometrical and wave optics), viz., to the problem of the propagation of rays in Riemann's 5-space of coordinates, time, and action. Geometrical 5-optics appears as a limiting form of the wave 5-optics, which includes, as a special case, the relativistic wave mechanics of Dirac.

1273 Action as a Space Coordinate. II. Yu. B. Rumer. Zhur. Eksptl. i Teoret. Fiz. 19, 207-14(1949)(in Russian).

The first part of this work appeared in Zhur. Eksptl. i Teoret. Fiz. 19, 86-94(1949). It is shown in the present paper that a comprehensive theory of gravitation and electricity is contained, as a special case, in a general theory of a 5-field that determines the metric in the 5-space of coordinates, time, and action. It appears that such a general field theory, including Einstein's gravitation, Maxwell's electrodynamics and the theory of the χ field, is described by Einstein's equations for the 5-space $P_{\lambda\mu} - \frac{1}{2}G_{\lambda\mu} = -\kappa Q_{\lambda\mu}$, in which $Q_{\lambda\mu}$ is the 5-tensor of the sources of the 5-field. Three cases are examined: (1) The classical case, in which there is no χ field and the metrics do not depend on x^5: A comprehensive field theory is given, comprising Einstein's gravitation and Maxwell's electrodynamics theories. (2) The weak 5-field in a vacuum: A generalized theory of gravitational waves is obtained that embraces the cases of gravitational, electromagnetic and χ waves. In the general case of a field depending on x^5, the theory becomes one of particles for which $e_0/m = c^2(\kappa/2\pi)^{1/2}$. These particles, called "fundamentons" by the author, play a part analogous to that of photons in electrodynamics, and it can be shown that the photon, the graviton, and the χ-field quantum are special cases of polarization of the fundamenton in its state

of zero charge. (3) Schwarzschield's problem in the 5-space: It is found that, in the close neighborhood of the source, the electric field created by a point charge does not follow Coulomb's law. Furthermore, a point charge always originates a χ field $\chi(r) = (\kappa/2\pi)^{1/2}(e/r)$ that is noticeable only at close distances from the charge.

1274 Action as a Space Coordinate. III. Yu. B. Rumer. Zhur. Eksptl. i Teoret. Fiz. 19, 868-75(1949)(in Russian).

In a non-Euclidian space, the introduction of spinors cannot be made without sacrificing the classical methods of description of the metric properties of space. A general covariant formulation of spinor equations becomes of practical importance in the author's 5-optics (Zhur. Eksptl. i Teoret. Fiz. 19, 86; 207(1949)), where the electromagnetic field is interpreted as a manifestation of metric properties of a 5-space of coordinates, time and action. The author has shown that it was possible to overcome the above difficulties by abandoning the classical method of introduction of a metrics with the aid of a fundamental tensor g_{ik}. In the present paper the author's new scheme of tensor analysis is presented, for the general case of an n dimensional space. It is especially adapted to serve the needs of the 5-optics, and permits a covariant formulation of spinor equations of physics. Starikin (Zhur. Eksptl. i Teoret. Fiz. 19, 749(1949)) has shown the fruitfulness of the method by deriving the laws of conservation of energy, momentum and charge in Dirac's theory.

1275 The Caloric and Thermal Equation of State in Quantum Statistical Mechanics. J. de Boer. Physica 15, 843-8(1949) Oct.

It is shown that in classical as well as in quantum mechanics the "dynamic" expressions for the caloric and thermal equations of state obtained with the method of quantum statistical mechanics are identical with the expressions obtained by the partition function method of statistical thermodynamics.

1276 Charge Conjugation for General Relativistically-Invariant Equations. I. M. Gelfand and A. M. Yaglom. Zhur. Eksptl. i Teoret. Fiz. 18, 1105-11(1948)(in Russian).

In the light of the results obtained by the authors in their work on Pauli's theorem for general relativistically-invariant equations (Zhur. Eksptl. i Teoret. Fiz. 18, 1096 (1948)), the question is discussed on the introduction of the concept of charge conjugation (Majorana, Nuovo cimento 14, 171(1937); Kramers, Proc. Amst. Acad. Sci. 40, 814(1937)) into the theory of relativistically invariant equations.

1277 Determination of the Phase of the Wave Function in the Scattering of Particles. G. F. Drukarev. Zhur. Eksptl. i Teoret. Fiz. 19, 247-50(1949)(in Russian).

A new method is proposed for the calculation of the phase of the wave function in scattering phenomena. The phase is defined as the asymptotic value of a certain auxiliary function satisfying a nonlinear first-order differential equation. The method furnishes more accurate values of the phase than does the numerical integration of Schroedinger's equation. Two cases are examined: (1) the spherically-symmetrical scattering ($l = 0$), and (2) the general case ($l \neq 0$); here l is the particle's momentum in $h/2\pi$ units.

1278 Eigenfunctions and Partition Function for a Hemispherical Rotator. R. V. Zak. Zhur. Eksptl. i Teoret. Fiz. 19, 182-3(1949)(Letter to the editor, in Russian).

Sokolov (Zhur. Eksptl. i Teoret. Fiz. 18, 767(1948)) has calculated the eigenvalues and the partition function for a hemispherical rotator. However, his enumeration of eigenfunctions is incomplete, and, accordingly, the value of the partition function at high temperatures is half of the true value. The author shows that the partition function of a hemispherical rotator is equal to 1/2 of that of a spherical rotator; this result is to be expected from purely physical considerations, by taking into account the space available to a hemispherical rotator. Sokolov's value is half that given by the author.

1279 Electrons in Perturbed Periodic Lattices. J. C. Slater. Phys. Rev. 76, 1592-1601(1949) Dec. 1.

It is shown that the motion of an electron in a periodic potential, such as is found in a solid, plus a slowly varying perturbative potential, can be derived from the energy in the periodic lattice alone, as a function of momentum or wave number. A Schroedinger equation is set up, in which the Hamiltonian is the sum of this energy in the periodic lattice—the momentum being replaced by a differential operator—and of the perturbative potential energy. The resulting wave function modulates atomic functions to provide a solution of the perturbed problem. This method is applied to give proofs of simple theorems in conduction theory, to discuss the energy levels of impurity atoms in a semiconductor, and to consider excitons; all are problems which have been considered before, but which are treated more straightforwardly by the present method. Applying the method statistically, the combined Poisson's equation and Fermi-Dirac statistics is set up for impurities in metals and semiconductors, and for the theory of rectifying barriers.

1280 The Equation of State in Quantized Kinetic Theory and Quantum Statistical Mechanics. H. S. Green. Physica 15, 882-90(1949) Oct.

A rigorous derivation is given of the equation of state of a fluid on the basis of quantum statistical mechanics, and it is confirmed that the thermodynamic pressure so obtained differs from the kinetic pressure derived from quantum hydrodynamics or otherwise. The difference is evaluated and it is shown that it becomes appreciable at very low temperatures.

1281 Gravitational Interaction of the Electrostatic and the "Mesostatic" Fields. I. Z. Fisher. Zhur. Eksptl. i Teoret. Fiz. 19, 271-2(1949)(Letter to the editor, in Russian).

In Zhur. Eksptl. i Teoret. Fiz. 18, 636(1948) the author has shown that the potential of a scalar "mesostatic" field in the neighborhood of a point source, when gravitational ef-

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fects are taken into consideration, has a logarithmic singularity instead of the usual singularity $\sim 1/2$. Using the same method, the author solved the problem of a spherically-symmetrical gravitational field in the neighborhood of an isolated particle having simultaneously an electric and a quasi-electric meson charge. In this case, the above sensitivity of the scalar field toward gravitation is even more marked. The electrostatic field is little perturbed by the scalar field, but the latter is radically modified and has lost its singularity at $r = 0$. This causes the total energy of the "mesostatic" field to converge, while the energy due to the electrostatic and gravitational fields remains divergent.

1282 Higher Approximations of Radiation Theory for the Klein-Nishina Formula. Max Robert Schafroth. Helv. Phys. Acta 22, 501-36(1949)(in German). (See also NSA 2-2190.)

The recent quantum electrodynamical methods of subtraction, respectively "interpretation" of divergencies, are applied, both in the momentum energy as well as in the space-time formalism, to the e^8 approximation for the Compton cross section. A convergent, Lorentz- and gauge-invariant formula for the necessary matrix element is derived. The cross section is calculated explicitly only for the case of low energies. The additional hypotheses necessary for the calculation with divergent expressions are discussed in detail. Special attention is given to the infrared catastrophe which is compensated correctly by the double-Compton-effect.

1283 A New Content of the Problem of Many Particles. A. A. Vlasov. Zhur. Eksptl. i Teoret. Fiz. 18, 840-56(1948)(in Russian).

It is a defect of the classical scheme of the problem of n bodies that it permits the assignment of arbitrary initial values of variables; in a theory incorporating the thermal movement of particles, considered as an existing natural process, any assignment of initial conditions is equivalent to a physical intervention that would completely destroy this process; such an intervention is beyond our actual experimental means. In the method presented by the author, Cauchy's problem is regarded as a physical operation of precisely that kind. For the point $t = t_0$, the distribution functions are not holomorphous with respect to $(t - t_0)$. No act of spatial localization of particles is possible without a radical interference with the processes of the system; however, a complex of processes can be realized and observed without such a localization act. In this the present scheme occupies an intermediate position between the quantum and the classical theories: like the former, it considers any assumption of a set of initial values as a physical act; like the latter, it postulates our ability both to perform that act arbitrarily and to discover processes that do not necessitate it. Gibbs's statistical mechanics is inconsistent when, after including the thermal movement, it bases itself on rigorous mechanical equations from which the thermal movement is excluded. In the author's scheme this situation is avoided by obtaining the equations of the thermal movement as solutions of initial equations.

1284 A Note on the Variational Method for the Scattering Problem. Su-Shu Huang. Phys. Rev. 76, 1878-9 (1949) Dec. 15 (Letter to the editor). (See also NSA 3-2351.)

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It has already been pointed out (Phys. Rev. 76, 866(1949)) that Hulthén's formulation of the variational principle (K. Fysiogr. Sällsk. Lund Förhandl. 14, No. 21 (1944)) has the advantage over other formulations (Hulthén, Arkiv Mat. Astron. Fys. 35A, No. 25, (1948); Tamm, J. Eksptl. i Teoret. Fiz. 18,337(1948)) in that a more flexible trial wave function can be used. However, he adopts a method of application which leads to a very inconvenient numerical procedure. Moreover, the variational principle is not used in its strict form. The author introduces several changes which make the method more rigorous and simpler to use. The revised procedure is then applied to the theory of S-scattering by a potential field of the Yukawa type, and the differences between the old and new methods are indicated. The problem of electron scattering from the hydrogen atom is being treated in the same manner. The calculations relating to this problem are now in progress.

1285 On the Multiple Production of Photons in Bremsstrahlung. Bernard d'Espagnat. Compt. rend. 229, 22-4(1949)(in French).

As is known, attempts to calculate, with the aid of the perturbation method, the diffusion cross section of an electron that emits radiation leads to a logarithmic divergence at the low frequency side of the spectrum ("the infrared catastrophe"). By using a different method, free of any assumptions as to the number of the bremsstrahlung photons, Bloch and Nordsieck (Phys. Rev. 52, 54(1937)) eliminated the above difficulty and obtained, as a result, an infinite number of photons. However, Pauli and Fierz (Nuovo cimento 15, 167 (1938)) showed that Bloch and Nordsieck's procedure leads to another logarithmic divergence, viz., at high frequencies; they, accordingly, assumed a break in the spectrum, (by introducing the point electron). The present author, accepting the multiple photon creation, shows a way to avoid the new divergence by considering the velocity variation of the decelerating electron as being essentially noninstantaneous. He, too (and independently of the point electron hypothesis), is led to the idea of a break in the spectrum. The differences between his results and those of his predecessors appear at very high frequencies only, indeed far beyond the Duane-Hunt limit; the values, given by those authors, of the diffusion cross section of decelerating electrons should be considered a good approximation.

1286 On Some Mathematical Methods in the Theory of Scattering of Particles. II. I. E. Tamm. Zhur. Eksptl. i Teoret. Fiz. 19, 74-7(1949)(in Russian). (See also NSA 1-1689.)

In an earlier work (Zhur. Eksptl. i Teoret Fiz. 18, 337-345 (1948)) the author has given a variational method for the determination of eigenfunctions of the continuous spectrum of Schroedinger's equation for a central potential field. There has been an error in the statement of the applicability conditions of the method; they are in reality much stricter than stated. A modified variational method is presented here, in conformity with the true conditions of applicability.

1287 Pauli's Theorem for General Relativistically-Invariant Equations. I. M. Gelfand and A. M. Yaglom. Zhur. Eksptl. i Teoret. Fiz. 18, 1096-1104(1948) (in Russian). (See also NSA 3-1157.)

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A similar article by the authors (On Relativistically-Invariant Equations Corresponding to a Definite Charge and a Definite Energy, Doklady Akad. Nauk S. S. S. R. 63, 371-4(1948)) was listed in Nuclear Science Abstracts as abstract No. 3-1157.

1288 Physical Solutions of the Point-Electron Equation. A. Loinger. Nuovo cimento 6, 360-7(1949) Sept. (in Italian).

This is a discussion of the criterion given by Caldirola (Nuovo cimento 5, 99(1948)) for the selection of physical solutions of Dirac's third-order equation of a point electron (Dirac, Proc. Roy. Soc. (London) 167A, 148(1938)). Several applications of the criterion are examined.

1289 Radiative Reaction and Damping in Scattering. J. Hamilton. Proc. Phys. Soc. (London) 62 A, 750-62 (1949) Dec. 1.

The higher order radioactive corrections and the damping corrections to the cross section for the scattering of an electron by an electrostatic potential are investigated. It is shown that the perturbation treatment of the radiative corrections at high frequencies joins on to the Bloch-Nordsieck solution for low frequencies. The damping effect arising from the low frequency photons is shown to be negligible, and a modified damping equation is proposed which gives a smooth transition to the damping correction in passing from high to low frequency photons.

1290 A Remark on the Scattering of Particles Whose Energy is Zero. I. Pomeranchuk. Zhur. Eksptl. i Teoret. Fiz. 18, 1146-7(1948)(in Russian).

It is shown that, in a case of a potential field having no bound levels, the effective cross sections of scattering of slow particles in such a field must satisfy certain inequalities which are derived here. In a field of attraction forces, the said cross section is always greater than the Born's approximation, and the amplitude of the scattered wave is positive; the opposite rules are true for the case of a field of forces of repulsion.

1291 Remarks on Non-local Spinor Field. Hideki Yukawa. Phys. Rev. 76, 1731(1949) Dec. 1 (Letter to the editor).

In a previous article (Phys. Rev. 76, 300(1949)) on quantized nonlocal fields the author assumed the commutation relation

$$\beta_\mu \left[x^\mu,\psi\right] + \lambda\psi = 0$$

between the space time operators x^μ and the nonlocal spinor operator ψ, in addition to the commutation relation

$$\gamma^\mu \left[p_\mu,\psi\right] + mc\,\psi = 0$$

between ψ and the space-time displacement operators p_μ. The difficulty arose that in contrast to the second, the first of these relations was not invariant with respect to the improper Lorentz transformation with the determinant -1, but was to change itself into the form

$$\beta_\mu \left[x^\mu,\psi\right] - \lambda\psi = 0.$$

Here it is shown that this difficulty can be avoided by replacing the first relation by

$$\tfrac{1}{6}\sum_{\kappa\lambda\mu\nu} \epsilon'_{\kappa\lambda\mu\nu}\gamma_\kappa\gamma_\lambda\gamma_\mu \left[x'^\nu,\psi'\right] + i\lambda\psi' = 0,$$

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where the $\epsilon_{\kappa\lambda\mu\nu}$ are the components of an antisymmetric tensor of rank four, equal to $+1$ or -1 when the (κ,λ,μ,ν) are an even or odd permutation of (1,213,4) and zero otherwise.

1292 Remarks on Spherical Electromagnetic Waves. V. Sorokin. Zhur. Eksptl. i Teoret. Fiz. 18, 228-35 (1948)(in Russian).

In radiation theory it is customary to deal with plane electromagnetic waves, even in problems, such as those concerning radiations emitted by an atom, where a consideration of spherical waves would be more natural. In problems with photons having a definite angular momentum, the use of spherical waves is fruitful and significant; thus, as is known, the selection rules are derived, by this method, without calculation, from the law of conservation of momentum, whereas, by using plane waves, the selection rules remain meaningless. The cause of the avoidance of spherical waves in physical theory lies, probably, in the unwieldy and asymmetrical shape of the formulas describing those waves (see e.g., Heitler, Proc. Cambridge Phil. Soc. 32, 112(1936), and Berestetskiĭ, Zhur. Eksptl. i Teoret. Fiz. 17, 12(1947)). By following the principle that, when resolving a vector field, vector spherical functions must be used, the author obtains simple and symmetrical expressions, as convenient in computations as are those representing plane waves.

1293 Traveling Electromagnetic Multiple Waves and a New Method of Field Quantization. G. Molière. Ann. Physik 6, 146-62(1949)(in German).

Using complex notation and following closely the Dirac theory of the electron-positron field, incoming and outgoing electromagnetic multipole waves of arbitrary order are investigated. Instead of the customary characterization as electric and magnetic multipole waves, they are distinguished by their state of polarization (circular and longitudinal). The investigation leads to the introduction of polarization variables which are analogous to the ρ matrices of Dirac. A modified method of quantization is proposed, which in the case of an electromagnetic field makes essential use of the polarization variables and leads to a finite field energy.

1294 Treatment of the Three-Dimensional Rotator by Means of the Laplace Transform. Max Päsler. Ann. Physik 6, 365-74(1949)(in German).

This paper is the sixth in a series discussing the application of the Laplace transform to the solution of the partial differential equations of mathematical physics. (Kallmann and Päsler, (1) Ann. Physik 2, 292(1948); (2) ibid 2, 305(1948); (3) ibid 4, 90(1948); (4) ibid 3, 305(1948); (5) ibid 4, 46(1948)). The specific problem considered here is the solution of the Schroedinger equation of the three-dimensional rotator.

1295 Applications of the Peierls-McManus Classical Finite Electron Theory. J. Irving. Proc. Phys. Soc. (London) 62 A, 780-90(1949) Dec. 1.

On the basis of the equations of motion for an electron in an electromagnetic field (proposed by Peierls and McManus (Proc. Roy. Soc. (London) 195 A, 325(1948)) the scattering cross section for radiation, in the case of an electron in a high frequency field, is found to depend only on the mechanical mass instead of the total mass, as in the point electron

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theory. For the scattering of fast electrons by protons the differential cross section for scattering depends on the mass in a more complicated way. Finite values are obtained for the deflection for all values of the impact parameter and for the total energy radiated in the collision.

1296 A Determination of the Mean Range of the Alpha Particles of ^{235}U. G. J. Van der Maas and J. L. Yntema. Physica 15, 807-24(1949) Sept.

A method of determining the mean range of U^{235} using a deep ionization chamber connected to a linear amplifier is described. The measurements were made on a nonenriched uranium sample. A special method was developed for the determination of the relationship between residual range in the chamber and the deflection of the oscillograph. Taking the mean range of U^{238} to be 27.02 mm (760 mm Hg 15°C), the mean range of U^{235} was found to be 29.00 ± 0.20 mm. The ratio of the number of α particles of U^{235} and U^{238} is in good agreement with the results of Nier (Phys. Rev. 55, 150, 153(1939)).

1297 Equation of the Curve of Total Absorption for a Polychromatic Radiation. J. Malvoisin. J. Radiol. Electrol. 30, 580-1(1949)(in French).

Whereas for monochromatic x-rays the intensity of the radiation, after traversing a certain thickness d of a substance, is given by the simple formula $y = y_0 \exp(-\mu d)$, (y_0 is the initial intensity, μ is the absorption coefficient of the substance), for polychromatic radiations no convenient formula is in use. Using a graphical method, the author derives the following expression for the intensity: $y = A_1 \exp(-a_1 d) + A_2 \exp(-a_2 d) + \ldots$; the papameters A's and a's are related to various components of the spectrum; usually only three terms can be obtained from the absorption curve, corresponding to three degrees of the penetrating power. In an appendix, an analytical deduction of the formula is given.

1298 Inelastic Scattering of Deuterons. J. R. Holt and C. T. Young. Nature 164, 1000(1949) Dec. 10 (Letter to the editor).

In a recent communication, Greenlees, Kempton, and Rhoderick (Nature 164, 663(1949)) report observations which indicate that deuterons may be inelastically scattered by nuclei of magnesium and aluminum. The present authors have independently reached a similar conclusion as a result of experiments in which a homogeneous beam of 7.5-Mev deuterons from the Liverpool cyclotron were the bombarding particles. Particles emitted from the target at angles within the range 25-145° from the direction of the incident beam were detected by a differential ionization chamber. Protons and deuterons near the end of their paths give rise to pulses of different amplitude, and may be distinguished from each other with the aid of a pulse height discriminator. Using such a method it was possible to measure the energy of the inelastically scattered deuterons and to obtain information about the excited levels of the aluminum nucleus. Similar measurements were carried out with a magnesium scatterer and a plot is given of the angular variation of intensity of the scattered deuterons in this case. Experiments with C, Ni, and Au indicated that inelastic scattering takes place in Ni also. There is evidence for the existence of an excited level of .82 Mev.

1299 Passage of Nucleons Through Matter. D. I. Blokhintsev. Zhur. Eksptl. i Teoret. Fiz. 19, 953-8(1949)(in Russian).

A theoretical study is made of decelerations of nucleons in which a proton is changed into a neutron or vice versa. A formula is given for the cross section of such processes, which is verified by using experimental data on the angular distribution of the elastic scattering (p,n). It is shown that, except for small energies, neutrons change into protons before their energy is spent in nuclear collisions; the "exchange path" L is smaller than the "nuclear collision range" R, the difference R-L increasing with the energy. An analysis is made of the changes that the number and the energy spectrum of protons (or neutrons) undergo when traversing matter. The "transparency" limits within the nucleus for impinging nucleons are given as a function of the latter's energy and of the atomic mass of the nucleus.

1300 Penetration and Diffusion of Hard X-rays through Thick Barriers. III. Studies of Spectral Distributions. P. R. Karr and J. C. Lamkin. Phys. Rev. 76, 1843-5 (1949) Dec. 15. (See also NSA 3-1459, 3-2319.)

Two kinds of spectral distributions of γ rays are discussed. These are (1) spectra found in an infinite medium with an uniformly distributed monochromatic source, and (2) equilibrium spectra obtained in an artificial penetration problem. Curves are shown for various media and for various energies of the source photons. The relations of these spectra to the general problem of γ-ray penetration is discussed.

1301 Penetration and Diffusion of Hard X-rays through Thick Barriers. IV. Multiply Scattered γ-Rays: Angular Distribution. L. V. Spencer and Fannie Jenkins. Phys. Rev. 76, 1885-6(1949) Dec. 15 (Letter to the editor).

In order to gain some insight into the angular distribution of γ rays which are scattered many times within a barrier, the following problem has been studied theoretically: A source of monochromatic γ rays of energy E_0 is distributed uniformly throughout an isotropic medium. Each γ ray is emitted in exactly the same direction. What will be the distribution in angle $N(E, \theta)$ of those photons which are degraded by Compton scattering to the energy E? (θ is measured from the initial direction.) Under these conditions $N(E, \theta)$ obeys an integral equation which may be simplified by expanding the function in Legendre polynomials. The resulting integral equations may be solved approximately. Numerical calculations were carried out for lead and aluminum and the general features of the solutions are described.

1302 Range-Energy and Other Relations for Electrons in Kodak Nuclear Plates. Marion A. S. Ross and Barbara Zajac. Nature 162, 923(1948) Dec. 11 (Letter to the editor).

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Kodak Nuclear Track plates of type NTP 2 have been exposed in a low resolution β-ray spectrograph with a line half-breadth of about 1 mm. Emulsions of two different sensitivities were used, the normal NTP 2a, and an experimental emulsion having larger grains and higher sensitivity than this type. In the normal emulsion, electron tracks with energies up to 80 kev could be followed, while the energy limit in the experimental emulsion was determined by the emulsion thickness. The ranges and energies of the observed particles are tabulated. Other tables give the grain distribution along the 100-kev tracks, and the relative stopping power of the emulsion for energies ranging from 35 to 90 kev.

1303 Some Simple Considerations Concerning the Back-Diffusion of Fast Electrons. W. Bothe. Ann. Physik 6, 44-52(1949)(in German).

The back diffusion of electrons from a thick wall is first treated as an albedo problem. This approach is successful for the less energetic electrons which are backscattered. Then an alternate diffusion theory is developed to describe some aspects of back-diffusion more exactly. The maximum of the energy distribution curves thus found is in good agreement with experimental results. Finally, a short discussion is given of the effect of single scattering on back-diffusion.

1304 Stopping Power of Nuclear Emulsions for Ionizing Particles. Hervasio G. de Carvalho. Phys. Rev. 76, 1729-30(1949) Dec. 1 (Letter to the editor).

The stopping power of an emulsion relative to air can be expressed by the empirical formula $s = R_o/R = A\beta^k$ where R is the range in the emulsion, R_o the range in dry air at 15°C and 1 atm, $\beta = v/c$ and A and k are constants depending only on the nature of the emulsion. Taking values of R as reported in the literature for protons, α particles and fission fragments, the author finds that for β ranging from 0.035 to 0.28 the empirical formula is well obeyed, with A = 2760 and k = 0.157 (Ilford C2 emulsion). For electrons the only published data refer to NT4 emulsions, which, however, do not differ from C2 emulsion by more than 2% in stopping power. Here again the empirical formula is correct for β between 0.3 and 0.8, although the dispersion about it is greater.

1305 Half-Life for Double Beta-Decay. C. A. Levine, A. Ghiorso, and G. T. Seaborg. AECD-2741, Oct. 21, 1949, Decl. Nov. 23, 1949. 5p.

Fireman (Phys. Rev. 75, 323(1949)) has reported the results of a rather difficult β-particle coincidence counting experiment in which the decay of Sn^{124} by the simultaneous emission of 2 negative β particles seems to have been observed. This note reports the results obtained from a different and somewhat simpler method of looking for the phenomenon of simultaneous emission of 2 β particles. The method consists of investigating uranium samples for 90-year Pu^{238} in the isobaric triplet U^{238}-Np^{238}-Pu^{238}. Pu^{238} would come from U^{238} by the double β-particle mechanism since Np^{238} is heavier than U^{238}, which in turn is substantially heavier than Pu^{238}. This chemical method of investigation is particularly applicable to this isobaric triplet because there appears to be no other mechanism to account for the Pu^{238} should it be found. The results are negative so far and show that this process is considerably less probable than in the case reported by Fireman (ibid).

1306 Isotopic Assignments of Bismuth Isotopes Produced with High Energy Particles. H. M. Neumann and I. Perlman. UCRL-524, Nov. 25, 1949. 34p.

A number of isotopes of bismuth have been identified from the bombardment of lead with high energy deuterons and protons. Evidence for these assignments is based chiefly on the daughter lead and thallium activities resulting from electron-capture decay.

Isotope	Half-Life	Mode of decay	Electron-capture decay products
Bi^{203}	12 hr	E.C.	52-hr Pb
Bi^{201}	118 min	E.C.	8-hr Pb
Bi^{201}	62 min	α,E.C.	72-hr Tl
Bi^{200}	35 min	E.C.	18-hr Pb 27-hr Tl
Bi^{198}	25 min	α,E.C.	80-min Pb 7-hr Tl
Bi^{198}	7 min	α,E.C.	25-min Pb 1.8-hr Tl
$Bi^{<197}$	1.7 min	α,E.C.(?)	

Those isotopes exhibiting α-decay have been investigated as to energy and half-life for this mode of decay. A discussion is given of the relationship between half-life and energy for all known α-active bismuth isotopes. (auth)

1307 Mass Spectrographic Identification of Radioactive Lanthanum Isotopes. R. A. Naumann, F. L. Reynolds, and I. Perlman. UCRL-528, Nov. 28, 1949. 7p.

Two neutron deficient isotopes of lanthanum, one new (La^{133}) and the other previously tentatively assigned (La^{135}) have been given mass assignments by the technique of dispersing the isotopes on a photographic plate with a mass spectrograph. These and other light isotopes of lanthanum were prepared and some of their radioactive characteristics determined by absorption methods and with a low-resolution β-ray spectrometer.

1308 Angular Correlation at Internal Conversion of γ Rays. V. B. Berestetskiĭ. Zhur. Eksptl. i Teoret. Fiz. 18, 1070-80(1948)(in Russian).

The problem of the correlation between the directions of γ quanta emitted by a nucleus at two successive transitions has been discussed by Hamilton (Phys. Rev. 58, 122(1940)). In the present work the angular correlation is examined for two cases: (1) emission of a γ quantum and of a conversion electron, and (2) emission of two conversion electrons. In the course of the discussion, the author refers to his paper on the inner conversion of the radiation of a magnetic multipole (Zhur. Eksptl. i Teoret. Fiz. 18, 1057(1948)).

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1309 The Beta-Spectrum of $_{61}Pm^{147}$. L. Lidofsky, P. Macklin, and C. S. Wu. Phys. Rev. 76, 1888-9 (1949) Dec. 15 (Letter to the editor).

A sample of Pm^{147} with high specific activity was obtained from the AEC at Oak Ridge, in the form of $Pm^{147}Cl_3$ in 0.1N HCl. The solution was evaporated to dryness and then redissolved in distilled water. A small drop of this solution was placed on a collodion backing, forming a layer of salt less than 30 g/cm thick. The β-ray spectrum of this source was then investigated. A Fermi plot of the spectrum is straight from the upper energy limit (227 ± 1 kev) down to 35 kev and the deviations beyond this point may be attributed to the finite thickness of the source and to window absorption. The energy spectrum has the allowed shape, although the transition should be a first or second order forbidden transition.

1310 Beta-Spectrum of Praseodymium 143. L. Feldman, L. Lidofsky, P. Macklin, and C. S. Wu. Phys. Rev. 76, 1888(1949) Dec. 15 (Letter to the editor).

A strong source of Pr^{143} was obtained from the AEC at Oak Ridge in the form of a PrCl solution. A drop of this solution, mixed with a detergent, containing about 20 μg of the salt, was placed on a thin collodion film. The radiation was then analyzed with a magnetic spectrometer, and the resulting Fermi plot is reproduced. This plot turns out to be a straight line from the upper energy limit (932 kev) down to 170 kev. The decay curve is definitely a straight line on a semilogarithmic plot and gives a value of 13.7 ± 0.1 days for the half-life. It is noted that the spectrum has the allowed shape although the transition should be highly forbidden.

1311 Conversion of a γ Quantum on a β Decay Electron. I. S. Shapiro. Doklady Akad. Nauk S. S. S. R. 67, 53-5(1949)(in Russian).

As an alternative to a β decay resulting in an excited state from which a γ quantum is emitted, one may consider the possibility of a transition involving an electromagnetic interaction between the created electron and the excited nucleus, so that the result will be equivalent to an "absorption" of the γ quantum by the electron. The operator of the interaction energy for this transition is $H' = H_F + H_R$, where H_F is the operator of the energy of interaction between the nucleons and the Fermi field (electron-neutrino field), and H_R characterizes the electromagnetic interaction between the electron and the radiation field of the nucleus. The process belongs to the resonance-fluorescence type, to which the known method for the solution of conversion problems is applied (Dankoff et al, Phys. Rev. 55, 122(1939)). The result shows that the probability of the process studied is very small.

1312 Directional Correlation between Successive Internal-Conversion Electrons. J. W. Gardner. Proc. Phys. Soc. (London) 62 A, 763-79(1949) Dec. 1.

For the internal conversion of successive electric multipole quanta by s-electrons, unaccompanied by spin reversal, the directional correlation between the ejected electrons can be derived by symmetry arguments alone. A general formula

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is established and special cases likely to be of practical interest are tabulated. Comparison is made with Hamilton's results for γ-γ correlation (Phys. Rev. 58, 122(1940)).

1313 The Disintegration of In^{114}. J. Y. Mei, Allan C. G. Mitchell, and Daniel J. Zaffarano. Phys. Rev. 76, 1883-5(1949) Dec. 15 (Letter to the editor).

Previous investigations indicate that the 50-day activity of In^{114} decays into a 72-sec isomeric state, which then decays, by β emission, into Sn^{114}. Recently Cork, Shreffler, and Fowler (Phys. Rev. 74, 1657(1948)) reported that In also emits a γ ray of approximately 0.8 Mev. The authors have made a spectroscopic study of this radiation, the results of which are in substantial agreement with those reported by other workers (Boehm and Preiswerk, Helv. Phys. Acta. 22, 331(1949)). They have, however, observed an additional γ ray not previously reported. Metallic indium was irradiated in the Oak Ridge pile, and the energies of several γ rays were determined from the energies of photo-electrons emitted from a lead or uranium radiator. Evidence was found of K-electron capture by the 72-sec isomer, followed by the emission of two gammas, one previously observed and one newly discovered. A decay scheme is given.

1314 The Experimental Determination by Ionization Methods of the Rate of Emission of Beta- and Gamma-Ray Energy by Radioactive Substances. The Isotopes Na^{24}, P^{32}, Co^{60}, and I^{131}. L. H. Gray. Brit. J. Radiology 22, 677-97(1949) Dec.

The known relation between the ionization in cavity type ionization chambers and the γ-ray energy absorbed per unit mass of the wall material has been employed for the absolute determination of the rate of emission of γ-ray energy by samples of the isotopes Na^{24}, Co^{60}, and I^{131}. When the rate of emission of quanta by the sample was determined by counting procedures, the measured rate of emission of γ-ray energy agreed well with expectation based on accepted decay schemes. The rate of emission of β-ray energy was then determined by lining the walls of the chamber with a gelatine suspension of the isotope in question, and the ratio of the two activities is given. The principles of the method and the factors that limit the accuracy are discussed in some detail.

1315 Half-lives of ^{141}Ce and ^{169}Yb. D. Walker. Proc. Phys. Rev. (London) 62 A, 799-801(1949) Dec. 1.

The half-lives of Ce^{141} and Yb^{169}, produced through slow neutron capture in cerium and ytterbium, have been redetermined as (33.11 ± 0.23) days and (31.83 ± 0.21) days, respectively. The errors appear to be smaller than in previous determinations (Seaborg and Perlman, Revs. Modern Phys. 20, 585(1948)).

1316 Internal Conversion of the Radiation of a Magnetic Multipole. V. B. Berestetskiĭ. Zhur. Eksptl i Teoret. Fiz. 18, 1057-69(1948)(in Russian).

In a previous work (Zhur. Eksptl. i Teoret. Fiz. 16, 672 (1946)), the author has calculated, in nonrelativistic approxi-

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mation, the coefficients of internal conversion of the radiation of a magnetic multipole on the K and L shells. For the K level, similar data have been obtained by Lowen (Phys. Rev. 67, 203(1945)). In the present paper the problem is re-studied, the former results necessitating several corrections. Extensive tables of matrix elements for the process examined are given.

1317 On the γ Radiation of Radiothorium. Michel Riou. Compt. rend. 229, 1225-7(1949) Dec. 5 (in French).
The absorption curves of radiothorium in copper and lead indicate the presence of three components of approximately 14, 86, and 84 kev. Further absorption studies of the 14-kev radiation show that it is composed of radiation from the L shell of radium. From absorption curves in Au, Hg, Tl, Pb, and Bi it was possible to fix the other energies as 84.00 and 86.48 kev and to show that these cannot be the K lines of radium. The relative intensities of the two types of radiation was also calculated, and the probability of excitation of the 87-kev nuclear energy level was deduced from these intensities.

1318 On the Production of Electron Pairs in the Field of an Electron. J. A. Phillips and P. Gerald Kruger. Phys. Rev. 76, 1471-7(1949) Nov. 15.
The ratio, $R = \sigma\text{-pairs}/\sigma\text{-triplets} = C(Z^2)ef/Zef$ for three gases, CH_4, air, and argon, has been studied and C found to be 3.63, 3.97, and 4.11, respectively. The average value of C from these data is 3.92 ± 0.26. The γ rays from $F^{19}(p,\alpha\gamma)O^{16}$ were used in this experiment. The measured energies of the γ rays as deduced from pairs formed in CH^4 are 6.13 ± 0.06 and 7.12 ± 0.07 Mev. Data on the energy distribution of the low energy negative electron of the triplet are included.

1319 Radioactive Lanthanum 140. J. M. Cork, H. B. Keller, W. C. Rutledge, and A. E. Stoddard. Phys. Rev. 76, 1886(1949) Dec. 15 (Letter to the editor).
A highly purified sample of La^{139} was bombarded with neutrons in the Oak Ridge pile, yielding radioactive La^{140}, which then decayed with a half-life of 41.4 hr. About 16 electron conversion lines were observed. Their energies are tabulated and the corresponding γ-ray energies are given. The K-L differences are characteristic of cerium, indicating that γ emission follows the loss of a β particle from the lanthanum nucleus. A tentative, but not entirely satisfactory, decay scheme is presented.

1320 A Short-lived Metastable State in Titanium-46. B. D. Nag, Sunil Sen, and Santimay Chatterjee. Nature 164, 1001-2(1949) Dec. 10 (Letter to the editor).
The half-life of a metastable state of Ti^{46} was determined by a method similar to that used by Bunyan et al (Proc. Phys. Soc. (London) 62, 300(1948)). Delayed γ-γ coincidences were examined with the aid of a variable delay coincidence circuit. Special arrangements were made for the calibration of the delay times and for the elimination of chance coincidences. The half-life is found to be 13.2 ± 0.8 μsec.